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TEACHING EARLY ADOLESCENTS TO THINK.

BY- BAUGHMAN, M. DALE

JUNIOR HIGH SCHOOL ASSN. OF ILLINOIS, URBANA

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A SERIES OF PAPERS DEALING WITH THE TEACHING OF THINKING TO ADOLESCENTS IS CONTAINED IN THIS REPORT FROM THE JUNIOR HIGH SCHOOL ASSOCIATION OF ILLINOIS. TOPICS INCLUDE--(1) A REVIEW OF THE LITERATURE ON THINKING AND TEACHING, (2) THE DEVELOPMENT OF INDEPENDENT THINKING, (3) FACTORS RELATED TO THINKING READINESS, (4) TEACHING PUPILS HOW TO THINK, (5) RELATIONSHIPS BETWEEN EMOTIONS AND THINKING, (6) THE ROLE OF INQUIRY IN LEARNING, (7) INQUIRY TRAINING, (8) THE USE OF THE INDUCTIVE METHOD IN TEACHING, AND (9) THE INFLUENCE OF MODERN MATHEMATICS ON THE TEACHING OF THOUGHT PROCESSES. MOST OF THE PAPERS INCLUDE BIBLIOGRAPHIES. LISTS OF FUTURE PLANS AND EXISTING BARRIERS TO TEACHING ADOLESCENTS TO THINK BETTER, OBTAINED IN A SURVEY OF 167 JUNIOR HIGH SCHOOL PRINCIPALS, AND STATEMENTS OF TEACHERS RELATED TO THE TEACHING OF THOUGHT PROCESSES IN ENGLISH, GEOGRAPHY, SCIENCE, MATHEMATICS, AND ART ARE INCLUDED. (AG)

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Edited by M. Dale Baughman

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TEACHING EARLY ADOLESCENTS TO THINK

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FOREWORD

The Junior High School Association of Illinois is a professional organization of schools which enroll pupils in the upper elementary grades and schools which are recognized as junior high schools. The major activities of the Association are (1) an annual conference in which there are general sessions featuring speakers of national reputation, demonstrations, and discussion groups; (2) drive-in conferences which deal with current topics of interest to junior high school educators; (3) a quarterly newsletter; (4) status studies on subjects of general concern; and (5) an annual publication growing out of the spring conference and the subsequent fall drive-in conferences.

The present study, *Teaching Early Adolescents to Think*, is the fourteenth in the current series. Previous publications are: *Pupil Grouping*, *Junior High School Curriculum*, *Guidance Practices*, *Teacher-Pupil Planning*, *Faculty Meetings*, *Extra Class Activities*, *School Community Patterns for Developing Better Citizenship*, *Challenging Talented Youth*; *Foreign Language Instruction in the Junior High School*; *Junior High School Curriculum*; *Pupil Evaluation*; and *Climate for Learning: Focus on the Teacher*. The discerning reader will note that the title *Junior High School Curriculum* appears twice in the series. The later study completed in 1961 repeated the earlier one for the purpose of making comparisons in curricular offerings in Illinois junior high schools.

Special recognition is extended to Tom Sinks, Evanston, LeRoy Greathouse, Sycamore, and James Martin, University of Illinois, for their singular contributions to the publication. Mr. Sinks and Mr. Greathouse, members of the Publication Committee, are principals respectively of Nichols Junior High School in Evanston and Sycamore Junior High School; Mr. Martin, who contributed the chapter on relevant literature, is a graduate assistant in the Office of Educational Placement, College of Education, University of Illinois. Sincere appreciation and thanks are in order for the various educators who prepared the papers which constitute the major portion of this publication. The list of contributors will be found preceding the table of contents.

The Association is certainly grateful to the many schools in Illinois which provided released time and other help for their staff members who contributed in one way or another to the publication. It is with generous thanks and sincere appreciation that the Association recognizes the invaluable work of the clerical personnel in the Educational Placement Office and the Stenographic Office in the College of Education, University of Illinois.

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REVIEW OF RECENT LITERATURE ON THINKING AND TEACHING

James E. Martin

The title of this annual publication, Teaching Early Adolescents to Think, is probably a misnomer. It can be assumed that by the time a pupil has reached the junior high school some form of "thinking" is taking place within the individual. A more appropriate title, then, is Teaching the Early Adolescent to Think BETTER. At the outset it must be pointed out that there is relatively little written about "thinking" or "teaching to think" at the early adolescent level per se. Much can be inferred, or referred to generally. Also, that which is written reflects many points of view, some of which seem to differ only in semantics, not in content. Those who wish to pursue the subject further are referred to the references at the end of this chapter and to the following references especially because of the extended bibliographies which they contain: (1) Wallach (36), 107 items; and (2) Woodruff (38), 134 items.

Various expressions as to the purposes of education have been raised. Devine (11) cites a recent publication of the Educational Policies Commission of the National Education Association as saying that the central purpose of American education is the development of the ability to think. Blair, Jones, and Simpson (4) point out that in a rapidly changing world, it becomes imperative that people develop the capacity to adapt to new situations, think critically, to make discriminations, think creatively, and make sound judgments. The day-to-day ability to recognize and solve practical problems as well as the concern with and ability to handle intellectual problems is one of the major goals of schooling. They go on to say that pupils should learn to learn and that that is the best the school can do for them. They should learn to learn by understanding, not merely learn to memorize. In a more verbal way Woodruff (38) speaks of the Progressive Education movement's calling attention to "the ability to think." He feels that there is now enough data in the literature that deals with human thought process to permit a growing awareness that human behavior contains a multiplicity of variables, all of which are going to require educational attention, and that the cognitive structure of the individual seems to occupy a strategic position in the middle of the whole picture. The phraseology of Johnson (22) is that while foundations for effective studying are laid in the elementary school and refinements are made as late as graduate school, the junior high school assumes the major task of helping pupils develop the attitudes and skills of independent students. Teaching pupils to want to learn and how to study is part and parcel of all instruction at the junior high school level. Rapparlie (31) echoes Blair, Jones, and Simpson to some extent when he says that all individuals must keep themselves informed so that wise evaluation is possible. In a democracy the people must choose for themselves in the best manner they can learn. They must be able to think for themselves, wisely and carefully. In our society children are constantly called upon to make choices for themselves. If they lack any real understanding of how to go about making these decisions wisely and if they do not even recognize the necessity for doing so, then it is little wonder that when the choices are made, they are made on whim and not on reflection. He feels that children should learn about judgment inside of school, not outside in situations where mistakes may be serious.

Somewhat contradictory views are expressed by Dale (9) and Hamm (19). Dale feels that the major job of the school is not to help the student cover the ground which he says is impossible anyway, but rather to help him to experience in depth certain phases of subject matter and at the same time learn how to attack and process life experience in its many forms. Hamm on the other hand implies that the purpose of the school, whether it be elementary, junior, or senior high school is to inculcate and indoctrinate immature members of the school community into the ways and means of society. Brown (6) summarizes by stating that schoolmen generally agree that education ought to include both acquisition of and inquiry into knowledge. He questions, however, which should come first, acquisition or inquiry.

If it is assumed from the foregoing that at least one of the purposes of education is to teach "thinking," some consideration must be given to just what "thinking" is or what it implies or connotes. It has been exceedingly difficult to separate "thinking" from "teaching" from "learning." Add to this one other dimension of many words meaning the same thing and the complexity of the task becomes more clear. The reader will have the opportunity to choose from the many definitions and explanations following those which he wishes to use. He will note also that there is not unanimity among the various writers. Referring first to Brown (6) just cited, he answers his question by saying that the teaching-learning situation can begin with either inquiry or acquisition. He says that it does not matter which comes first as long as the emphasis in teaching and learning shifts from one to the other and back again, over and over, in some sort of harmony and balance. Brown does not define either of the two words, acquisition and inquiry. It can be assumed that the common definition of each can be used. Kemp (23) defines learning to mean a change in attitudes and behavior. Blair, Jones, and Simpson (4) refer to two major kinds of "thinking": problem-solving and creative thinking. Ausubel (2) says that problem-solving is not necessarily meaningful and by and of itself is not conducive to meaningful discovery. He expresses the opinion that too much has been made of learning by discovery, although it does have its proper place among the repertoire of accepted techniques available to teachers. He warns that it is not to be considered a panacea. Kirk (24) cites five basic operations of the thinking process: (1) cognition (recognition or discovery); (2) memory (retention of what is cognized); (3) divergent thinking (reorganizing known facts into new relationships); (4) convergent thinking (arriving at more conventional conclusions); and (5) evaluation (reaching decisions as to correctness or adequacy of what is known). Osborn (27) calls upon Webster's definition of cognition as "the process of knowing, knowledge, or...a product of this process, as a perception." In its broadest sense, cognition refers to thinking. He goes on to use Ausubel and Fitzgerald's definition of cognitive structure (from "Meaningful Learning and Retention: Intrapersonal Cognitive Variables") as "an individual's organization, stability, and clarity of knowledge in a particular...field relative to meaningful new learning tasks in this field." Phenix throws in the word meaning and indicates that it is intended to express the full range of connotations of reason or mind. He gives four dimensions of meaning: (1) experience; (2) rule, logic, or principle; (3) selective elaboration; and (4) expression. The present analysis of the fundamental patterns of meaning shows that thought does not follow only one logical pattern, such as the method of scientific problem solving advocated by the Experimentalists, and therefore, no single answer can be given to the question of how we think. He gives a rather involved description as follows: In the languages thought follows the pattern of arbitrary symbolic construction. In the sciences the methods are those of classifications, hypothesis formation, generalizations and explanation by the use of theories and models. In the arts thought proceeds by perceptual abstraction through particular presented forms. In the personal realm thought consists in the existential realization of intersubjective relationships. Moral thought involves deliberate decisions to act in consideration of principles of right or consequences of good. Historical thinking integrates understanding through re-creation of past events in the present. Religious thought unites finite and infinite by the symbols of ultimacy. Philosophical thought consists of analytic, synthetic, and critical evaluation of meanings by the use of interpretive concepts.

To further cloud the issue let's look at still more definitions. A concept, according to Woodruff (38), may be defined as some amount of meaning more or less organized in an individual mind as a result of sensory perceptions of external objects or events and the cognitive interpretations of the perceived data. The role of concepts in thought processes has been examined in various ways. Thinking is the process of organizing and storing concepts in which concepts already present are instruments. This introduces learning how to learn. He states that one of the most significant conclusions reached was that students simply do not know how to go about the process of problem solving. They must have the concepts in subject matter if they are to engage in problem solving behavior, but they must also be taught concepts of problem solving behavior. Inhelder and Piaget (21) say that formal thinking is both thinking about thought and a reversal of relations between what is real and what is possible. Peel (28) lists four kinds of thinking: thematic, explanatory, productive, and integrative. By thematic he means the imaginative thinking called up in creative writing, painting, and music. This thinking is fairly free in that the writer is bound by no particular practical problem which he has to solve. Explanatory thought is the kind of thinking connected with describing and explaining events and things. Productive thinking is the kind of thinking which gives rise to material changes, inventions, and new products. The fourth kind of thinking is a sweeping, comprehensive quality which seems to be at the very apex of thought--co-ordinating or integrative thought. All of his kinds of thought subsume sensori-motor and language activity. For Peel the very basic mechanism of thought is that of relation-finding or association. A little better understanding of his four kinds of thinking is obtained when his four are matched with the more traditional classification as follows: Thematic - Imaginative; Explanatory - Reflective; Productive - Constructive; and Integrative - Co-ordinative. Broudy, Smith, and Burnett (5) give four typical uses of knowledge or school learnings: replicative, associative, applicative, and interpretive. These are fairly self-explanatory and are used to lead up to their asking whether critical thinking is an interpretive or an applicative use of schooling. By critical thinking they mean the scrutiny of discourse for truth and validity. Good thinking has both form and content. The form is provided and regulated by logic, or the rules for correct definition, classification, and inference. Good thinking or critical thinking also involves knowledge about the field in which the thinking is being done. Kolesnik (25) defines thinking as the deliberate ordering of ideas toward a conclusion; the process of drawing inferences or of discovering concealed relationships; the systematic rearrangement of concepts. A concept, in short, is a universal idea which applies to all objects of a particular class and distinguishes the object from those in other classes. He identifies three different forms or modes of thinking as reasoning, critical thinking, and problem solving. Reasoning is the basic form of thinking in which concepts are reorganized in such a way that a new meaning or understanding emerges from previously established knowledge. Two forms of reasoning are deduction, reasoning from the general to the specific, and induction, from the specific to the general. Critical thinking is the reorganization of concepts so as to evaluate some object or proposition. Problem solving is the reorganization of concepts or the restructuring of experience so as to overcome an obstacle and attain a goal. According to Kolesnik any of these three forms of thinking occurs when and only when at least two conditions are met: something is known and something is unknown. Knowledge of subject matter is a necessary condition of good thinking, but it alone is not a sufficient condition.

Fleck (14) claims that critical thinking can be taught. Devine (11) says that we cannot teach critical thinking as such, that we can teach about critical thinking. He feels that we can only postulate the existence of a critical *reading* or critical *listening* ability. Ennis (12,13) gives a root notion of critical thinking as meaning the correct assessing of statements. He took his basic notion from B. O. Smith in "The Improvement of Critical Thinking," *Progressive Education*, March, 1953. Smith said that if we set about to find out what a statement means and to determine whether to accept or reject it, we would be engaged in what we would call critical thinking. Since Smith's definition does not use any words like "correct," his notion is slightly different than Ennis' definition. Smith's concept of critical thinking permits us to speak of "good" critical thinking and "poor" critical thinking without redundance or contradiction.

The foregoing has been a hodge-podge of many people's ideas on thinking and its various aspects. Two threads seem to be running through the write-ups: (1) Order and/or logic is important, and (2) critical thinking seems to be the most stressed and structured. Perhaps when we use the general word *thinking*, we really mean *critical thinking*. Before going on to ways of teaching or improving thinking, some attention must be given to the developing mental ability of the adolescent.

Much early work in mental development was done by Inhelder and Piaget (21). They contend that the adolescent theory construction shows both that he has become capable of reflective thinking and that his thought makes it possible for him to escape the concrete present toward the real of the abstract and possible. To understand the role of formal structures of thought in the life of the adolescent, they found that in the last analysis they had to place them in his total personality. The adolescent commits himself to possibilities. They insist that in this tendency of the adolescent to formulate and test hypotheses lies the real explanation of much of his idealism, theorizing and criticism of parents and adult values. Chapter 6 shows very clearly how the propositional thinking of the adolescent differs from the concrete thought of childhood and Chapter 18 provides an interesting discussion of the possibilities of extending the scope of propositional thinking to all the cognitive fields that interest the adolescent. Phenix (29) touches on this latter point by saying that how well a person learns is also greatly affected by the factor of motivation. In addition, the possibilities of learning depend on the maturation of the individual. Besides maturation, the possibilities of learning are influenced by previous learning. The combination of maturation and earlier learning determines what a person is capable of learning at any given time. The developmental concept of readiness refers to the condition of being optimally prepared for some particular learning experience. Human beings, he says, are extraordinarily adaptable, and by appropriate preparation can be made ready for learning.

At the beginning of junior high school, most individuals enter a period of formal operations according to Broudy, Smith, and Burnett (5). At this point in their development, they are able to manipulate symbols in various logical ways. The individual has reached the point at which he is capable of thinking in purely abstract terms, systematically using the sorts of formal operations characteristic of scientists, mathematicians, philosophers, and others who engage in rigorous intellectual work. Gesell (17) treats the 12 and 13 year old extensively in chapters six and seven respectively. He gives much detailed information on the maturity profile at each age level and the differences are striking. This point is substantiated by Peel (28). Referring to Piaget's three levels in the development of relation finding and co-ordinating--intuitive, concrete, and propositional--Peel says that in the main the thinking of the primary school pupil is closely tied to the concrete situation present in his immediate experience at the time of study. He thinks and solves his problems in terms of actual elements of the situation. The principal data of childhood thought are the concrete realities. Toward the end of childhood, however, and in the beginning of adolescence the pupil begins to carry out logical operations on symbolic and abstract material. He goes on to say that there is little research material on the logical thinking of adolescents. The young adolescent may still find it easier to deal with concrete rather than abstract categories. But the ability to form concepts from abstract data is rapidly improving during early adolescence and is a necessary intermediate phase to be passed through before the pupil can later think in terms of propositions and formulate hypotheses. Since the capacity to reason formally does not usually emerge before the secondary years, the formal logical problem or syllogism is not utilized extensively in tests or learning situations intended for younger children. Peel's book is a very good source and is highly recommended. He points out that as every teacher will readily confirm, the actual picture of the growth of thinking in a class of pupils is far from simple. There are slow and rapid developers, and a particular child may be forward in one field but not so advanced in another. Three complicating factors must be considered: (a) differences between the pupils' intellectual capacities; (b) differences between the inherent difficulty of the task and field; (c) differences in the experience and sophistication of different pupils. Peel feels that Piaget's account of the child's intellectual development is really a learning theory, depending heavily upon ideas of maturation and readiness. True learning involves the acceleration of development due to added experience and teaching.

This point of view is born out by Wallach (36) also. The older child, in contrast to the younger, seems much more oriented to a consideration of hypothetical possibilities and to their systematic analysis. For the older child to be clear concerning what is involved in verifying a law, he must be able to formulate propositions and hypotheses about external events and objects and make various kinds of logical linkages, such as implication, disjunction, etc., about these propositions and hypotheses. The younger child's major cognitive attainments concern his increasing skill in dealing with external events and objects. The older child, obviously with the aid of his increasing linguistic competence, proceeds to describe the results of these dealings in propositions and then to relate the propositions in various ways. These kinds of considerations led Inhelder and Piaget (the Geneva group according to Wallach) to describe the adolescent's thought as "interpropositional," as involving "operations upon propositions," in contrast to the younger child's direct operations upon external objects and events. Yudin and Kates (39) support the above views. In a study with 12- to 16-year-olds they found that the 14- to 16-year-old subjects were significantly superior to the 12-year-old subjects in concept attainment efficiency. The strategies employed by the older group were also superior to those of the younger. The results suggest that the stage of formal reasoning operations begins about the age 12 and reaches equilibrium at about 14-16 years of age. Two other articles present points just a little different from what has already been said and do contribute possible reasons for some problems which occur in the transition stage of adolescence. Pierce (30) indicates that most of the teachers in the elementary school are emphasizing the development of the whole child. The pupil's abilities and personality can be carefully considered in the contained classroom and he understands his role and purpose in school. The contained classroom provides the psychological background for developing self-sufficiency and self-discipline and still makes it possible to maintain motivation. But then when the student reaches the secondary school, he goes from class to class and from teacher to teacher, each of whom has maybe 100 other students to worry about. His sense of his own special individuality begins to fade. Junior high school, then, being self-contained in some cases and departmentalized in others must provide the continuity between elementary school on the one hand and high school on the other. Tate and Straub (35) did a study on Catholic and public school children. So far as the thinking abilities required in scholastic achievement were concerned, the evidence supports the hypothesis that students from public schools are superior to those from Catholic schools. The differences in critical thinking are significant, but just why is not obvious. Success in the Critical Thinking test used would appear to require the subject to abstract the pertinent facts, adopt and hold a set for the pertinent facts, weight each fact appropriately, integrate the resulting information, and single out the correct or logical alternative. They, by way of explaining the differences, say that it is a recognized principle of Catholic education that every subject taught should emphasize Catholic tradition and faith. Moreover, they continue, the teaching methods tend to be authoritarian and memorizing and drill are stressed, whether or not the pupil understands.

Now, having given a miscellany of definitions and explanation of terms, and having explored some of the developmental background concerning the adolescent, our attention should turn to ways of teaching them to think, if this is possible to do. Obviously, Subject Matter, Methods, and Techniques will enter into the consideration of the topic. Hullfish (20) suggests that it is probably heresy to maintain that the real issue is not one of content but of the way in which whatever is deemed to be important is taught. He says that we cannot assume that hard subjects (whatever this designation means) will discipline the mind by exercising and strenghtening a faculty of reason. We can no longer assume that thinking will somehow emerge as a sufficient quantity of knowledge is accumulated. Of course, knowledge is a necessary ingredient of the thought process, but it does not of itself generate thinking. Thinking for Hullfish is a distinctive form of behaving and, as such, it has to be learned. The whole purpose of having a classroom is to increase the opportunities for young people to participate in reflective activity. He feels that the advancement of thinking is the responsibility of each teacher. Four things are needed:

1. First is the teacher's determination to make the classroom an exciting place, a place in which both individual and ideas are respected, a place in which knowledge is given work to do as it is used to check out the adequacy of ideas;

2. Next is the teacher's familiarity with the background--educational, social, physical, and cultural--of his students so that he may the more readily discover ways in which to stimulate their interests in the knowledge which it is his responsibility to teach;

3. Third is the teacher's increasing control of his field of knowledge, especially of its relationships to other fields of knowledge and to problems of his society. His is the responsibility of creating and maintaining a reflective atmosphere; and

4. Last is the teacher's familiarity with the ways in which ideas may be both engendered and tested.

The teacher is not the only one involved in this venture. Hullfish says that those who administer schools, those who supervise programs and activities, are as responsible as classroom teachers for the development of the reflective quality of the educative situation.

Ennis (12) raises a number of questions such as What methods of teaching are most appropriate? Should the criteria of critical thinking be made explicit or left implicit? Do different groups need different approaches: boys and girls; social class-groups; high, medium, and low mental ability groups? Must class size be kept at twenty-five, or can classes be increased in size--perhaps to hundreds or thousands? And how can teachers be prepared to teach their students to think critically? a course in logic? a course in Critical Thinking? a course in the logic of teaching? a special methods course? on-the-job training? a heavy dose of their subject matter? Freides, Fredenthal, Grisell, and Cohen (15) touch upon the first question very succinctly when they say that given present educational methods, or perhaps no matter what the educational methods, it is likely that most children will display some or all of the transition from concrete to abstract interpretation during adolescence. It is unlikely that many educational leaders will subscribe to the "all" of the previous statement. Peel (28) raises the related question of how far teaching can promote thinking and the converse relationship of the effect of thinking upon the pupil's attainments in school subjects. Peel devotes much time to the teacher and the promotion of thought. At the later stage of the transition from concrete to formal thought, added experience of the pupils in carrying out experiments combined with comments, suggestions, and criticisms by the experimenter or teacher can bring about the change to formal judgment. Too much teaching, he feels, or too wide a gap between instruction and thinking level may achieve not understanding but only mechanical skill. Several pieces of research on the understanding and meaningful learning of arithmetic have demonstrated that by making the pupil aware of the essential structure and meaning of the process or problem, learning and thinking become more efficient. He goes on to say that concrete thought, formal thought, combinatorial grouping, and the transformation of hypotheses from the one, organic structure and development, implying the inner essentials of problem-solving, to the other, might take us to the stage of understanding the essentials of reasoning power which generalizes to all fields. One of Peel's main points is that the principal role of thinking in the learning process is to bring about real understanding. The net results of the researches he referred to is to show that understanding--in the sense of a meaningful insight into the material and the relating of it to established understandings--must precede drill and exercise.

More has been written about critical thinking. Ennis (12) lists the following twelve aspects of critical thinking: (1) grasping the meaning of a statement; (2) judging whether there is ambiguity in a line of reasoning; (3) judging whether certain statements contradict each other; (4) judging whether a conclusion follows necessarily; (5) judging whether a statement is specific enough; (6) judging whether a statement is actually the application of a certain principle; (7) judging whether an observation statement is reliable; (8) judging whether an inductive conclusion is warranted; (9) judging whether the problem has been identified; (10) judging whether something is an assumption; (11) judging whether a definition is adequate; and (12) judging whether a statement made by an alleged authority is acceptable. These aspects can be taught, but Ennis emphasizes that research is needed in the areas of evaluation of and teaching of critical thinking. Maw (26) has shown that fourth-, fifth- and sixth-grade pupils can improve their performance on critical thinking tests through study of materials on selecting relevant facts, judging the reliability of data, making inferences and generalizations, and evaluating arguments. Her materials for study somewhat reflect some of the 12 aspects listed by Ennis. Devine (11) gives ten of the many critical reading abilities which can be taught:

1. The ability to distinguish between relevant and irrelevant information

2. The ability to judge the reliability of a source

3. The ability to distinguish between statements of fact and statements of opinion

4. The ability to judge the suitability of material for a particular purpose

5. The ability to recognize the bias of a writer

6. The ability to distinguish between the emotive and report languages

7. The ability to recognize the inferences that a writer has made

8. The ability to recognize the assumptions implied by a statement

9. The ability to determine the recency of a printed statement, and

10. The ability to recognize the competency of a writer to write about a given subject.

Devine states that it is the language arts teacher who can best translate the postulated critical thinking abilities into operational terms, and it is in the language arts class where pupils will have the best chance of becoming critical thinkers. Rapparlie (31) points out that critical listening is important and requires an open, critical mind that is willing, upon finding cause, to accept and instigate change. Glaser (18) has shown that the performance of high school students on critical thinking tests can be improved through study of the elements of logic and the psychology of thinking combined with practice in analysis of errors. Day (10), through a six weeks summer course for exceptional children (eighth graders), showed what they could do in the use of digital computers and problem solving. Contrary to popular belief, no "electronic brain" actually thinks. It merely does the work man tells it to do, but, and this is the important point, in an orderly and infinitely shorter period of time. The adults involved in that summer course were astonished and amazed by the ability, curiosity, and enthusiasm shown by the eighth-grade students. Tate and Stainer (34) studied two groups of 117 seventh and eighth graders who were selected as good and bad problem solvers and who were matched on I.Q. and age. They were given tests of critical thinking and practical judgment. It was found that success in the critical thinking test required the subject to abstract the pertinent data from a paragraph, adopt and maintain a set for the pertinent data, weight each datum appropriately, integrate the resulting information, and single out the correct or most logical choice. The test of practical judgment required, in addition to practical information and evaluation of past experiences, the ability to delay or inhibit response until the competing answers had been analyzed and weighed. Tate and Stainer observed that it seemed reasonable to suppose that systematic study of errors of judgment would improve the thinking abilities of both teachers and students.

A warning note is voiced by Ausubel (2) when he says that learning by discovery takes place (if at all) in contrived situations. The development of problem-solving ability is, of course, a legitimate and significant educational objective in its own right. Hence it is highly defensible to utilize a certain portion of classroom time in developing appreciation of and facility in the use of scientific methods of inquiry and of other empirical, inductive and deductive problem-solving procedures. To be sure, Ausubel believes, the critical thinking and problem-solving abilities of most pupils can be improved. This is a far cry, however, from saying that most pupils can be trained to become good critical thinkers and problem solvers. He feels that it would be more realistic to strive first to have each pupil respond meaningfully, actively, and critically to good expository teaching before endeavoring to make him a good critical thinker or problem solver. Taba and Elzey (33) also point out a discrepancy in that classroom learning experiences are not usually designed to provide a cumulative sequence in the maturation of thought which is at once psychologically sound and logically valid. They listed the specific processes in three cognitive tasks to be (1) concept formation, (2) the making of inferences and the induction of generalizations from interpretation of specific data, and (3) the applications to explain new phenomena and to predict the consequences of certain events and conditions.

The chief task of teaching, then, is to determine the order of learning tasks and to pace each step appropriately. This is the crucial point in the formulation of teaching strategies, and one against which current teaching methods commit the greatest errors. Taba and Elzey feel that most current studies of classroom transactions concentrate more or less exclusively on the analysis of the psychological functions of teaching acts. This emphasis has evoked the criticism that teaching is explained and controlled exclusively in terms of psychological principles and that the logic of teaching and of its product in learning is overlooked. Another critical voice, in part, is from Dale (9). He says we must master the habit of sustained attention, develop the power to resist distraction, and to learn to focus on a problem with full concentration. In mastering any subject, in learning to learn, we map the field, note its basic principles, its key ideas, its conceptual structure. The crux of learning is to develop a conceptual scheme for skillful filing of experience. Critical self-evaluation looms large in the process of learning to learn. It is important for the student to learn to ask both how and why. The objection is that schools have typically emphasized learning to learn through reading and writing, and have neglected critical guidance in the listening process.

Kirk (24) suggests a number of ways for developing creative thinking in young people: brainstorming, stimulating sensitivity to problems, encouraging ideational fluency, encouraging originality, and encouraging redefinition ability. How effective these are, he says, must await the results of current and future research. Cassel (7) assumes teaching and learning to be highly interdependent functions, and unless some learning ensues, there can be no teaching taking place. He suggests six independently organized phases of the teaching act: (a) learner readiness; (b) pacing or individualizing; (c) goal setting and goal striving; (d) affectivity and learner aspiration; (e) transfer; and (f) evaluation. Transfer, to be sure, is the ultimate goal of all teaching acts, and research findings relative to transfer emphasize the following:

1. School should be life-like and employ problem-solving activity in a social utility setting;

2. Teaching should emphasize principles and generalities that are both meaningful and developed by the students;

3. Learning should be experience-centered for the student;

4. The student should be consciously aware of the outcomes expected, including the transfer value; and

5. Negative adaptation should be utilized when the positive approaches appear ineffective.

Kolesnik (25) feels that there are several classroom procedures which can be expected to contribute to the development of attitudes and abilities. The specifics of these procedures will vary with the subject being taught and the maturational level of the students. But first and perhaps most important, every teacher--in any kind of school at every grade level--should encourage and reward independent thinking. The student must be stimulated with a problem to think about--a problem in which he is genuinely interested, one which he feels a need to solve. The teacher should strive to give assignments--as homework as well as classwork--which emphasize the *why* or the *how*, rather than simply the *who*, *what*, *when*, or *where*. Many teachers, unfortunately, says Kolesnik, pay lip service to the fostering of independent thinking, but they scold or otherwise penalize their students for expressing interpretations different from those of the textbook, and reward conformity and the reproduction of the teacher's own views. Ausubel (1) states that in sequential school learning, knowledge of earlier appearing material in the sequence plays much the same role as an organizer in relation to later appearing material in the sequence. Sequential organization of subject matter, combined with the use of appropriate advance organizers, can be very effective in classroom learning because each new increment of knowledge serves as an anchoring post for subsequent learning. Sequential organization presupposes, of course, that the preceding step is always clear, stable, and well organized. Hence new material in the sequence should never be introduced until all previous steps are thoroughly mastered.

Phenix (29) suggests four principles for the selection and organization of content as means of ensuring optimum growth in meaning: (1) the content of instruction should be drawn entirely from the fields of *disciplined inquiry*; (2) the selection of content is such that from the large resources of material in any given discipline, those items should be chosen that are particularly *representative* of the field as a whole; (3) the content should be chosen so as to exemplify the *method of inquiry* and the modes of understanding in the disciplines studied. It is more important for the student to become skillful in the ways of knowing than to learn about any particular product of investigation. Knowledge of methods makes it possible for a person to continue learning and to undertake inquiries on his own; (4) the materials chosen should be such as to arouse imagination. The teacher's task as a mediator of knowledge is to humanize the *disciplines*, by showing that knowledge in each of its various kinds has meaning for all rather than for an exclusive group of professionals. The method chosen in any given unit, course, program, or curriculum, says Phenix, depends upon the intention of the teacher or curriculum maker, be it to communicate, to describe and explain, to create interesting perceptual forms, to gain direct existential insight, to respond to the claims of conscience, to gain a comprehensive perspective, or to fulfill any combinations of these intentions. Effective teaching depends upon the use of some reasonable pattern of organization, so that instruction is not haphazard and so that the course of study is not a series of miscellaneous experiences having no clearly defined plan or purpose. In learning the methods of inquiry the student is stimulated to active engagement with the subject. In being concerned with methods, he cannot assume a role as passive recipient of what Alfred North Whitehead called "inert ideas." Methods are ways of doing something, modes of active investigation. Therefore, instruction in the characteristic method of inquiry in the disciplines enlists the vital participation of the student and thus speeds the acquisition of meanings.

Cousins (8) reflects much the same attitude as above. The acquisition of the skills by which pupils identify and solve problems can be accelerated if instruction is purposefully oriented to develop proficiency in reflective thinking. By reflective thinking Cousins means the understanding and interpretation of materials, developing and testing insights, exploring generalizations, and reconsideration of previously accepted ideas. He recommends eight things:

1. Teachers should attempt to create a classroom atmosphere which is conducive to the development of critical thinking.

2. If reflective thinking is to be achieved, teachers should avoid questions which are primarily concerned with who, when, or where, and should more often use questions of the why variety.

3. Textbook materials should be regarded as a beginning, rather than an end as far as instructional materials are concerned.

4. Whenever possible, the teacher should relate historical problems to the present.

5. Teachers who attempt to encourage discussions of a reflective nature should guard against permitting pupils to assert points of view without any substantiating support.

6. Pupils cannot be expected to exhibit the same amount of improvement in the skills of reflective thinking.

7. The teacher attempting to teach by reflective methods should guard against reverting to more traditional types of examinations.

8. It is important that teachers be brave enough not to worry about the false controversy of facts versus reflective thinking.

Going beyond the justification of reflective methodology as an accumulation of facts, pupils learn how to approach problems, to seek tentative solutions to problems, to probe these solutions for their logical deductions, and to test statements for unstated assumptions and implications. In short, says Cousins, pupils are taught to think rationally and logically.

Two articles touch upon two topics related to the general topic but remote from it. Smith (32) starts out by defining a logical operation as a verbal operation, the correctness of which can be ascertained by the degree to which it corresponds to the requirements of logic. The categories into which the episodes were classified and which, accordingly, represent all the logical operations performed by teachers and pupils are as follows: defining, classifying, conditional inferring, explaining, comparing and contrasting, evaluating, designating, describing, stating, reporting, substituting, and opining. He then makes this important point: "It is clear from our analysis that neither the logic of discussion nor the logic of the subject matter of instruction is understood by teachers save at a common sense level." What teachers have been taught about problem solving is largely what has been lifted from a psychological version of the process of problem solving. The psychological description contains no standards by which to determine whether or not the thinking taking place in the process is dependable, rigorous, and clear. For this reason, a great deal of what passes for problem solving is little more than undisciplined thinking and discussion. No matter what style the teacher follows, or what method he uses in his classroom work, it is extremely important that he understand the logic of instruction. For effective instruction it is just as essential that he understand the logic of teaching as it is that he understand the psychology of learning. This article touches upon the need for improvement of teacher education. The next article by Bing (3) brings in the influence of the home. Relations have been found between cognitive abilities and perceptual and cognitive style on the one side and personality traits on the other side. Democratic homes, maternal acceleration, and a warm, positive family atmosphere have been reported to increase the rate of growth of children's intelligence, especially verbal ability. Certain conditions possibly impede the development of nonverbal skills, like numerical and spatial ability. Bing suggests that antecedents for such differential development were maternal overprotection, emphasis on verbal accomplishment, and a demanding discipline with emphasis on academic achievement. Similarly, overanxious discipline and tense parent-child relationships were postulated to be responsible for low nonverbal, especially spatial, ability in children.

A study of 1157 eighth-grade pupils from 16 schools by Wilcox (37) was based on the hypothesis that the effects upon pupil skill in critical thinking brought about by the grouping of junior high school pupils will vary with the degree of homogeneity of mental age achieved within the groups. All analysis of variance failed to show any significant relationship between homogeneity of grouping and achievement of critical thinking. Therefore, it was concluded that grouping was not a contributing factor. Hamm (19) felt that the emphasis in the junior high school should be upon student participation and involvement. Broudy, Smith, and Burnett (5) agree with this last point. They say that to manipulate and maneuver students so as to involve them is more important than to know how to handle the subject matter of instruction. Kemp (23) too follows this line of reasoning when he says that research in the behavioral sciences shows that the best assurance of change results from four conditions, one of which is that the student must be totally involved through feeling, action, and thought.

From all of this certain statements can be made in summarization:

1. The teacher can teach critical thinking, or just thinking, or aspects of critical thinking.

2. The teacher must know subject matter, logic, psychology of learning, and the logic of teaching.

3. The student must be actively, totally involved in the learning process for effective teaching and learning to take place.

Gage (16) warns against inevitably futile attempts to develop a single theory that will embrace all the phenomena that go under the single name of teaching. He says, and it is quite true, that the teacher will manipulate the learner's environment, in accordance with the laws of logic and cognition, in the same way that he can influence another person's perceptions by manipulating the environment in accordance with the laws of perception. Johnson (22) has stressed the most important point of all when he stated that

> "...the teacher remains the key person in the program."

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DEVELOPING INDEPENDENT THINKING IN THE JUNIOR HIGH SCHOOL

J. Richard Suchman

Children don't have to be taught how to think any more than they have to be taught how to breathe. Long before the child is subjected to formal education he is exercising his intellective powers as he perceives, orders and analyzes his world, and constructs abstractions and theories that enable him to distill from his concrete experiences certain ideas that give him the power to predict, control and explain his environment.

The curriculum of the play-pen is an open system. No goals are set for the learner; there is no scope or sequence. There is no systematic attempt to reward or reinforce various kinds of responses. The preschool infant is free to observe and experiment, to gather data and formulate his own notions as to the nature and properties of his physical and social environment.

The child's early view of his universe is admittedly crude and circumscribed but it is his picture, painted by him from his own raw data and has meaning to him in terms that he understands. Given the limitations of an immature mental apparatus and a restricted field of operations he nonetheless constructs amazingly effective operating systems.

It is interesting to note certain facts about this intensive period of learning: First, there is a high level of motivation to inquire. The infant spends hour upon hour probing and manipulating. It is rather doubtful that he does this with the intention of "learning" or "discovering," but the fact of the matter is that he does learn and at a very rapid rate. Secondly, the learner at this stage exhibits an enormous amount of conceptual flexibility. He can easily reorder his conceptual structures in the light of new data that become available. As a result of this flexibility, his conceptual schemes can readily grow and expand as new informational inputs become available to him. Finally, it is clear that the learnings that emerge from these transactions are highly articulated with reality. No system or scheme generated by the child is ever more than a step away from the concrete observed events which gave them form. At this stage of development the child's knowledge is functional and relatively concrete.

Learning at the play-pen level is a form of inquiry. Most of the learning problems that are encountered at older age levels, such as low motivation and the tendency for children to either construct or accept conceptual systems which are not articulated with reality, are simply not present at this stage. How nice it would be to recreate some of the aspects of the play-pen mode of learning in the school setting.

When the child gets to school, the rules are changed. Other people have begun to make many of the decisions that used to be the child's own. Formerly he programmed his own learning by turning to the various sources of information that were available when and how he wished. The infant in the play-pen is in charge of his learning process and does not lean heavily upon others to lead the way. In school he must surrender most of his autonomy. Play is play and learning is learning. He must apply himself and study to achieve. By achieving he will receive rewards; approval, success, status, self-satisfaction. Not only does the control now come from the outside, but the satisfactions do as well. Learning tends to lose its open quality of search, exploration and play. The excitement is gone; now it is work, and much less pleasant.

The program to which he is subjected was prepared by somebody who had to plan in terms of some generalized standard child. But no child is standard, so the program never quite fits the unique motivational, or cognitive patterns of an individual child. Materials are presented on the basis of some formula that was considered appropriate for a given grade or age. The child works at it until he has mastered the acquisition of the information and concepts presented.

By the time the child is of junior high school age he has come to depend on others to structure and regulate his learning. He has learned the "rules of the game" and has either accepted them or has turned away from the programmed learning of the school toward areas where he does not have to give up his autonomy.

This course of events is not necessary. It is brought on by educational systems that set up unrealistic goals and fail to take into account the nature of the learner.

This brings us back to the original statement that children do not have to be taught how to think. But they do need freedom and support to be able to think their way to new levels of understanding. Learning does not have to be a matter of conforming to the programs of others. Meaningful learning starts from wherever the learner is, conceptually, cognitively, and motivationally. This means that every step forward for an individual child is a function of what the child already understands, how he thinks, and how he is motivated.

A powerful motivating force is the desire to find out why. Puzzling events that don't match the child's concepts of reality prompt inquiry. Children will go to great lengths to build and test theories that can account for discrepant events.

Another motivation is the desire to act and become involved. Learning cannot be passive. The inquiring child who is given the chance to gather his own data and test his own theories becomes committed to the search, and is rewarded by the satisfactions that grow out of the process of inquiry itself.

Junior high school is the beginning of a period of refocusing on the social and biological self. It takes an imaginative program to keep the boys and girls intellectually involved in the world of ideas that don't directly relate to their present social and biological status. While these children are struggling with these problems of growth, teachers are often at their wits end to keep the motivation to learn at a level where meaningful learning can take place.

At this stage it becomes increasingly vital to capitalize on the most powerful motivating forces available. On many fronts these children are fighting a battle for more autonomy, particularly at home.

Given a chance to generate knowledge rather than just to take in, store, and retrieve other people's conclusions, children gain a dimension of freedom that puts a new premium on thinking and inventing. The teacher who gives his pupils this autonomy has to expect that they will not necessarily arrive at the "approved conclusions." You can't have your cake and eat it too. It is true that one doesn't find many Isaac Newtons in the eighth grade, but consider what can result from giving a child a chance to build and test his own theories. The consequences look something like this:

1. An involved and motivated learner who has a real sense of responsibility for his own education.

2. A new appreciation of how knowledge comes into being through inquiry, and a set of strategies for engaging in the process.

3. A recognition of the relativity of knowledge; of the fact that data are concrete and verifiable, but that conclusions and explanations are the inventions that give meaning to data.

4. A sense of self-esteem that comes from building theories that have power, and can be used time and again to predict, control and explain.

5. An emerging set of conceptual models that are meaningfully articulated with reality as opposed to the empty generalizations that result when children are forced to store and retrieve abstractions they did not construct and which are not rooted in concrete experiences.

Today the typical classroom fails to create the necessary conditions for inquiry. Many are downright hostile to it. The first step toward changing this is to create a teaching faculty that believes in inquiry, that is made up of active inquirers. Only a teacher who thinks open-endedly can maintain open-endedness for his pupils. Such teachers need an administrative climate that gives them the room to approach the teaching-learning process through the inquiry mode. Teachers who are forced by a rigid curriculum to "cover" a given set of materials are thereby barred from the open-ended approach. There is no sure way to produce powerful thinkers in the classroom, but this power does grow as children actively pursue understanding. The school can create the conditions that stimulate and sustain such pursuit. Open questions and challenging problems set the stage. Rich informational resources provide raw materials for inquiry; and freedom for the pupils to operate autonomously and attack the problems in their own terms opens the door to productive thinking.

SOME THOUGHTS ON THINKING

Calvin K. Claus

Descartes argued himself into existence with the now-famous basic proposition, "I think, therefore I am." Undoubtedly, this revelation was personally satisfying to Descartes. At the same time, however, this also reveals one of the peculiarities of the human event which is referred to by the verb *think*. This event takes place in the very personal, private, under-the-skin world of a single human being. This event becomes accessible to the public world only under certain conditions. In Descartes' case he uttered as well as wrote the phrase "I think...." This, however, would be insufficient evidence upon which to base the inference that he did, in fact, think. Descartes went on to write and talk further on matters philosophical. Then, and only then was the public world in a position to conclude that he did think.

Here, then, is a long-standing problem with respect to the event called thinking; it has a private as well as public aspect. In a very real sense, every educator is forced to make a decision as to which of these two aspects will be his primary focus in organizing learning activities. Quite frequently, though, this decision is never verbalized by the educator. What are the consequences of each of these decisions? If the choice is made to deal with the private, under-the-skin world of the student, a severe limitation is immediately placed upon the educator. All discussion about thinking must now be restricted to inferences and assumptions about what might be going on under the student's skin. The educator peacefully glides along on this sea of assumptions in bliss (the hallmark of ignorance). Everyone assumes that everyone else is in nearly perfect agreement as to the meaning of the verb *think*. For those who hold this point of view, the initial focus is on the methods and materials to produce something called thinking.

On the other hand, for those who choose to deal in terms of the public aspect of thinking, there is a totally different starting point. Rather than first asking what it is that I, as an educator, must do to teach a student how to think, such an educator initially poses the following type of question: what must a student do that would lead a group of observers to say, "That student does solve a certain type of problem using certain symbols and/or materials." Here it is not even necessary to use words such as *think* or *thinking*. On the contrary, there may be a deliberate attempt to avoid such words, and to emphasize, instead, a clearer specification of the various types of problem solving behaviors a student does exhibit or is expected to exhibit, publically.

This private world vs. public world aspect of thinking can be dramatically illustrated by reference to the development of Helen Keller. Having been cut off from the rest of the world with respect to the visual and auditory senses, it could have been assumed that she was thinking. This being the case, Helen Keller could have been left alone to think beautiful thoughts in her own private, under-the-skin world. However, her parents concluded that that was not the case. In their opinion Helen did not do or say certain things in a desirable way. Furthermore, she did do and say certain things in a quite undesirable way from their point of view. Ultimately, the miracle wrought by Ann Sullivan was not that she taught Helen Keller how to think, but rather than she taught Helen to react to the public world in certain ways via publicly observed language and publicly observed actions. In turn, the world was then in a position to react to Helen via language and action.

The criterion measure (the proof-of-the-pudding, as it were) of Ann Sullivan's methods and materials, was that Helen Keller did do and did say certain things. In short, there was a desirable change in her overt, observable behavior. Whether or not she was then thinking beautiful thoughts turns out to be an irrelevancy. Other methods and other materials might have been more or less successful, but the public criterion measure always remains open to view.

The term "educational objective" could be taken to be almost synonymous with the more technical term "criterion measure." If educational objectives are stated with precision, using overt, observable behavior as the referent, an observer can record that a learner either does or does not do what the educational objective calls for. As mentioned earlier, educators might put aside terminology such as "thinking" and focus attention on a clearer specification of the various types of problem solving behaviors a student does exhibit, publicly. To aid in such specification, a set of educational objectives could start with a standard lead-in phrase such as The student does. Next would come an action verb on the order of suggest, list, name, ask, combine, compare, contrast, differentiate, rearrange, etc. To illustrate this, reference can be made to some thirty-nine different "thinking abilities" which Torrance (3, pp. 34-38) has summarized from the work of J. P. Guilford. Following are a few examples.

The student does:

suggest two improvements for a common appliance.
list problems that might arise in connection with common objects.
point out the way in which a described plan or activity is faulty.
name an object that could be made by combining two specified objects.

Other illustrations could be taken from the work of Suchman (2, p. 8).

The student does:

ask questions aimed at verification of objects.
ask questions aimed at verification of events.
state cause and effect relationships in question form.
phrase generalizations in question form.

At issue is not whether one uses the particular categories of behavio suggested by Torrance or Suchman. Rather, the main point to be estab is that educators might better focus their energies on attempting to clarify the behavioral outcomes expected, and stop debating about the inferential inner workings of a student's thinking. The examples given above are merely a tentative starting point. As these examples now stand, behavior can be more clearly evaluated; the student either does or doesn't do these things.

A poem penned by B. F. Skinner (1) captures the spirit of this argument. One stanza of the poem reads:

> Let not the strong
> Be cozoned
> By _Is_ and _Isn't_,
> _Was_ and _Wasn't_.
> _Truth's to be_ sought
> In _Does_ and _Doesn't_.

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THINKING READINESS

M. Dale Baughman

Considerable writing and some research emphasizing the thought processes of learners have been produced in the past half-dozen years. A few scholars have focused their studies on critical thinking; perhaps even more have delved into the intricacies of creative thinking. Now and then one finds the writers and researchers using the terms "inductive" thinking and "productive" thinking. Whether we speak of critical thinking, creative thinking, productive thinking, inductive thinking, or just the plain variety of thinking the teacher has in mind when she exhorts, "Think, Mike, Think!" or "Eddie, you are just not thinking!" it is important that we recognize and contribute to the major efforts being made to improve the thinking ability of pupils.

While no attempt will be made to equate reading readiness for primary grade pupils with thinking readiness for junior high school pupils, there may be somewhat of an analogy here in certain respects. Just as the first-grade teacher receives pupils with various degrees of reading readiness, so does the junior high school teacher come face to face in grade seven with pupils representing many levels of thinking readiness.

It may well be that junior high school teachers, especially those in charge of seventh-grade classes, would be wise to develop a thinking readiness program. Such a program, conceived as an integrated rather than a separate and independent activity, would strengthen and supplement efforts to improve the power of clear and concentrated thinking.

The writer is not prepared to present details or offer suggested steps in creating a thinking readiness approach. However, some factors basic to ideal conditions come to mind. They are:

1. Emotional security.
2. Pupil respect for and confidence in the teacher.
3. The preoccupied mind.
4. Observations and first-hand experiences.
5. The question.
6. The balk in the head.
7. A stimulating classroom environment.

Emotional security. Particularly difficult in the early adolescent is the separation of the emotions from thinking. Any number of stimuli may seriously hamper or even temporarily block constructive thinking in these emotional chameleons. Daydreaming, imagination, and mental woolgathering characterize many junior high school pupils who are not always ready to shift to a "thinking" mood when the teacher directs. The effective teacher is one who remains sensitive to the emotional whims of junior high school pupils as they are related to thinking. One aspect of the emotions, anxiety--as it affects thinking--is discussed in a pamphlet by Lighthall (2). Careful study of the research findings described in this pamphlet might increase teachers' comprehension of anxiety as a factor in the thinking process.

Anxiety, of course, is only one of many facets of the emotions of the early adolescent. Consistency on the part of the teacher, along with some insight into the moods of her pupils, is like psychological bedrock for the development of thinking readiness. Emotional security is associated with the next factor of respect and confidence.

Pupil respect for and confidence in the teacher. As the teacher grows in comprehension of pupil emotions, more than likely she is concurrently well on her way to winning their respect and confidence. That such pupil perceptions of teachers enhance thinking readiness hardly requires elaboration. Perhaps it is wise to point out that faith in the teacher, as a prelude to purposeful and concentrated thinking, is as the oar is to the rowboat.

The preoccupied mind. Because of moods, emotions, reveries, etc., junior high school learners bring to the classroom an assortment of preoccupied minds, which in effect are barriers to be circumvented, if real thinking is to result. Breaking through these barriers requires ingenuity and resourcefulness on the part of the teacher. The right word, the timely trick for attention-getting, or an appropriate demonstration may do the job, but there is a more serious basic problem, that of improving listening habits. Long an act accepted by both pupils and teachers as second nature, listening promises to become an intriguing new educational frontier.

There is little doubt that analytical and critical listening are supportive of, if not necessary to, analytical and critical thinking. Therefore, effective listening can be included in a program of thinking readiness. Readers are referred to a pamphlet by Stanford E. Taylor (3) which succinctly and interestingly presents the theoretical and practical conditions for teaching-listening in a planned program.

Observations and first-hand experiences. As a basis for thinking, careful and systematic observation is uniquely important for typical learners in primary and early elementary grades. Such experiences also have their place in the junior high school where procedures which lead from the concrete to the abstract contribute significantly to the inductive process in mind behavior.

Recording continuing observations, shaping up the problem, and sticking to the point are progressive steps which add strength to readying pupils for more difficult learning tasks. These steps are described in a bulletin of the United States Department of Health, Education and Welfare (1).

The question. One may argue that the teacher's skillful use of the question is a first step in thinking. Although this point is conceded, the writer views the question when used effectively as an integral phase of thinking readiness. Reversing the situation, that is, where pupils are taught systematically to ask pertinent questions, one may conclude correctly that these pupil acts also indicate thinking. They do, but again it is maintained that pupils must be guided into a behavior pattern of asking significant questions which sets the stage for further experiences in improved thinking.

In essence, the point is that a questioning pupil contributes more significantly to thinking than does an answering teacher. The Illinois Studies in Inquiry Training support this point of view (4).

The balk in the head. As a youth in rural Indiana this writer soon learned why a mule balks. The difficulty lies in the mule's head, not in his legs. In terms of pupil thinking, the difficulties a teacher encounters lies not always in a given set of circumstances but perhaps more frequently in pupils' reactions to those circumstances.

The pupil balks when he feels helpless, ignored, insecure, put off, dependent and anxious. The symptoms of balk are obvious to the practiced observer. Absence of participation, half-hearted participation, boredom and incompleted or even unattempted assignments indicate the balk in the head.

A stimulating classroom environment. The previous six factors when properly handled may nearly satisfy this, the seventh and last condition. Perhaps though, there are additional elements in the classroom climate appropriate for thinking readiness.

Much has been written about the physical setting for stimulation of thinking. While of doubtless value, this particular influence will not be discussed in this brief paper. Instead, attention is drawn to problems of group interaction. Surely, acceptance and tolerance of others in groups, plus the exchange of facts and ideas, affect the conditions of readiness for thinking, be it of the individual or group type.

Improved thinking in junior high school pupils will not occur automatically. Since we believe that youth must learn to think more critically, more creatively, and more productively, we must plan carefully for teaching the thinking skills in all subjects. We might call such planning a thinking readiness program which would include such factors as emotional security, pupil respect for and confidence in the teacher, the preoccupied mind, observations and first-hand experiences, the question, eliminating the balk in the head, and a stimulating classroom environment.

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TEACHING PUPILS HOW TO THINK: SOME DIVERGENT THOUGHTS

Robert F. Eberle

Let there be no delusions, pupils are being taught how to think. Instructors are doing a magnificent job in teaching pupils how to think--logically. There are, however, other types of thinking processes that are as important as logical thinking. Too little effort is being made to assist pupils in developing these other mental faculties. If they are taught at all, it is by accident or chance, rather than by design and understanding. Before we can expect instruction to be based on the five primary mental abilities described by J. P. Guilford, it will be necessary for instructors to have an understanding and workable knowledge of these concepts. To provide properly for instruction based on these concepts and to allow pupils to engage in exercises that will strengthen the use of these concepts, some alterations in the instructional program will need to be made. Instructors will need to be able to categorize the many instructional activities that are planned for the classroom. As technicians of the teaching trade, instructors will need to identify the various thought processes in which pupils are caused to engage.

If this sounds like more work, it is. If you see yourself grabbing the ring on another educational merry-go-round, wait, and engage in some thinking yourself. Ask yourself the question, really--now really, what is your job in its broadest aspects? Is your prime function to assist young people in their preparation for effective social and economic living in a democratic society? If the answer is in the affirmative, think along with me and test the following tenets for acceptability. Will you agree that:

With an ever-expanding preponderance of knowledge available to the learner, to expect him to learn so many things that he will be prepared to meet most of the situations he will encounter in his personal and professional life is positively absurd and not in keeping with reality. To develop those qualities that will assist him in coping with the many and varied experiences, whatever they might be, is more in keeping with reality.

The utilization of mental qualities such as intelligence and imagination must be included in the curriculum. To emphasize these qualities during the formative early adolescent years is aptly correct.

The improvement of mental qualities must essentially be the heart of the schools' program. Qualities other than logical thinking must also be developed. While some modification of the program must be made if we are to achieve our objectives, initially, the understanding of the nature of instruction in both the logical and informal thinking processes is imperative.

Logical thinking involves "exact reasoning," and falls in that somewhat formal, systemized portion of the mental processes. Instructors and pupils alike understand and place a high value on this type of thinking. Wilbur, of M.I.T., separates the informal mental processes into those that lead to values and those that lead to concepts. The first is represented by judgment, wherein reflection on past related experience leads to the formulation of values through comparison and discrimination; the second is represented by imagination, wherein some processes of the mind lead to the formulation of mental images or concepts.

Judgment and imagination may be conscious and deliberate. They may be demanding of a certain period of time. Again, they may be almost entirely subconscious and instinctive. From the conscious point of view, the ideation may seem to be instantaneous.

Recognizing the importance of logical thinking, nevertheless, we may conclude that present limitations of the uses of our thinking abilities are due in part to the overemphasis and rather inclusive emphasis on the logical processes. Logic finds its greater uses in lending support to the informal faculties. The informal faculties seem to be as important and possibly even more significant among the mental capacities. Einstein has said that, "Imagination is more important than knowledge." Imagination and ideation form the framework for all that has been, is, or will be. To claim that education is successful in teaching pupils how to think without a deliberate effort and a planned program is a falsehood. The informal faculties as well as the logical must be developed.

The need and authority for a change in instructional emphasis toward teaching pupils how to think informally has been with us long enough to expect some action. This authority may be found in the studies of J. P. Guilford, working in the Department of Psychology at the University of Southern California. Guilford's model for the complete "Structure of Intellect" lists five mental operations. An understanding of the five primary mental abilities of human intellect will allow the classroom teacher to categorize the associated thought processes. In so doing, it will be possible to determine the kind and degree of "thoughtfulness" being emphasized in the classroom. In brief, the five primary mental abilities may be described as follows:

I. Cognitive Ability
   discovery, recognition, comprehension, awareness, and understanding

II. Memory
   storage and retention of knowledge--what has been cognized, ability to recall information when needed

III. Convergent Thinking
   redefinition, transformations, recognized best or conventional solution, improvisions

IV. Divergent Thinking
   scanning stored information, searching for many possible solutions, thinking in different directions, ability to go off in new and untested directions

V. Evaluative Abilities
   goodness, suitability, adequacy, determination of fit, ability to determine if produced solution fits the problem

Already confused by the confluence of change resulting from the head-on meeting of the forces of the population and knowledge explosions, even the most sincere professional finds reason to face the future with fear and indecision. It is only through the realization of the awesome and bewildering dependency placed upon us, that we are able to place our feet firmly on the ground and take one more step ahead into a shadowy future.

Perhaps the place to start is with Guilford's Five Primary Mental Abilities. We might ask ourselves, "What activities might I introduce in my classes that will allow pupils to develop thinking abilities?" Listed here are "the abilities" and the types of activities that lead to the development of the associated thinking processes:

Cognitive Ability:

Activities that:
- generate curiosity
- provide rediscovery
- require comprehension
- cause awareness

Convergent Thinking:

Activities that:
- transform
- redefine
- develop the ability to pick best of choice of several alternatives

Divergent Thinking:

Activities with:

Fluency: Quantitative--
- generation of a quantity of IDEAS, words, titles, responses, phrases, sentences, uses
- generation of synonyms, analogies, similarities
- organization into systems of logical theories

Flexibility: Quantitative--
- number of considerations of properties, attributes, or inherent characteristics of problems or products
- freedom to make changes in approaches, or changes in strategies
- changes in direction of thinking
- unusual, remote, clever, or uncommon responses
- production of detailed steps, variety of implications and consequences

Evaluative Ability:

Activities that:
- produce conceptual foresight
- raise pertinent questions
- cause sensitivity to problems
- require curiosity
- note defects and observe imperfections
- develop purposeful judgment

A planned program which interweaves the thinking processes with the prescribed course of study will do much to prepare pupils to cope with the personal, educational, and professional situations they may encounter as students and contributing American citizens.

PERSONALITY FACTORS OF THE ADOLESCENT AFFECTING CRITICAL THINKING

Alicia Tilley

The period of adolescence seems the most appropriate for intense emphasis on habits of critical thinking. Adolescents continually question life and the life processes in an effort to establish their own perceptions of the world around them. They are persistent in their efforts to determine the significance of established patterns of behavior and of knowledge; they are quick to reject existing models that appear to have little relevance for their own particular life goals. This inquiry into the meaning of reality and the values of their culture could be a strong motivating force for the examination of many questions at a greater depth than is possible at other age levels. The psychological climate of this phase of growth could provide stimulation for an increased interest in consequence and purpose in the problems of living and learning.

There are several factors in adolescent development that affect the ability for critical analysis of various problems. Perhaps the most important of these is the change in the cognitive functioning that occurs at the beginning of the junior high school period (1). At this time, students become increasingly less dependent upon concrete-empirical experience and become more intellectually mature. They are more capable of handling abstract concepts without reference to concrete reality. They are able to manage more general terms and to grasp hypothetical relations between abstract ideas, to deal with symbols rather than objects. The secondary student is ready to cope with a greater depth as well as with a greater volume of subject matter.

As a result of the increased capacity to manipulate and to understand the abstract, the adolescent is more skillful in discovering relationships and in judging outcomes. He seems to welcome the opportunity to think through significant problems and to defend his position on various issues. His interest in and his willingness to engage in such activity, however, are governed by his perception of the importance of the question in relation to his own aims. Jersild (3) indicates that it is this attempt to grasp, in general intellectual terms, some of the things he believes and the values to which he feels personally attached, or the wish to clarify for himself some of the meanings he holds, that causes the adolescent to utilize his capacity for abstract thinking.

Although it may appear to be inconsistent, at the same time that the adolescent is testing the world of ideas and values in relation to himself, he is becoming intellectually more capable of identifying himself with people and circumstances outside his immediate environment. In choosing persons who symbolize his own ideals or values, he mentions characters from history or from fiction or from current events, as opposed to the younger child who tends to choose personal acquaintances for this purpose. Along with this intellectual growth in identification, there is an increase in the capacity to view things objectively, including both the self and others. This interest in self-improvement and in understanding others usually takes the form of an evaluation of interpersonal relationships.

The implication here is, of course, that the adolescent's view of himself is interwoven with his view of others and with his ideas concerning the way others view him.

Of great significance in our culture is the ability of the adolescent to anticipate the future and to plan for it. This capacity to project himself into adulthood and to organize his activities toward a particular educational or vocational goal becomes more and more important as our society grows more specialized. Young people are forced to make early choices of careers and to begin preparation for these careers much sooner than their parents did. This and other developmental tasks are forces that help to shape the adolescent personality in our civilization.

According to Havighurst (2), there are ten developmental tasks that must be given particular attention during the adolescent period. These are: (1) achieving new and more mature relations with age mates of both sexes, (2) achieving a masculine or feminine social role, (3) accepting one's physique and using the body effectively, (4) achieving emotional independence of parents and other adults, (5) achieving assurance of economic independence, (6) selecting and preparing for an occupation, (7) preparing for marriage and family life, (8) developing intellectual skills and concepts necessary for civic competence, (9) desiring and achieving socially responsible behavior, and (10) acquiring a set of values and an ethical system as a guide to behavior. The successful accomplishment of one, or of all, of these tasks demands some analysis of situations and of interrelationships. In fact, Havighurst suggests that the school utilize a variety of materials and methods which would encourage reflective thinking. He proposes that, in a democratic society, the highest performance of developmental tasks requires thinking through the situation before acting. Reflective thinking at its best involves thinking ahead and foreseeing both the moral and material consequences of projected actions, and then choosing the plan of action that promises to have the best consequences as measured by the values of such a society.

Those who have had experience in working with adolescents have probably recognized many of the psychological characteristics and developmental traits in the foregoing discussion. They are, no doubt, somewhat uncomfortable with the picture that all adolescents experience these factors at the same time. The fact is, however, that in intellectual and emotional maturity adolescents are just as varied as they are in physical development. Chronological age does not determine the speed with which the individual reaches or accomplishes these steps toward adulthood. Differences in ability also influence the degree of success that each adolescent can be expected to achieve in this area. This process can best be characterized as a continuing sequence of events which occur at varied times within the period of adolescence. It is possible that, for some individuals, the period of adolescence may continue throughout the remainder of their life span.

If we agree that the presence of certain personality factors during the period of adolescence would encourage emphasis on critical thinking, what then? I should like to quote a passage from Jersild which seems to point out our obligation as secondary school personnel:

> ...we should try, as far as possible, to give all young people the opportunity to develop their own potentials, to realize as fully as possible the resources latent within them. This does not mean that we thereby will make geniuses of them. There probably is nothing we can do in the education of the adolescent to create a genius. To most of us, with our ordinary minds, this would be an utterly impossible assignment, and even the greatest genius probably could not make a genius out of someone else.
>
> But all adolescents, whether modestly or richly endowed, have something in common with genius: the growth process is strong within them; within their own limited domain, they are capable of breaking new trails of thought, they are able to learn to see the old and familiar in a new light, to discover something within themselves and within their relationship to others that might enable them to take a more enlightened and productive approach to their present circumstances and to their future. What the individual learns, discovers, grows into when thus given a chance to develop may be humble when viewed against the stature of genius. But, when viewed in the light of what it means to the adolescent himself, it is important (3).

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EMOTIONS AND THINKING

Robert M. Johnson

My subject, Emotions and Thinking, is a broad one. Quite obviously, in the short space allowed, I will not be able to cover it in the depth that is needed to make it really significant. I, therefore, had to choose a few aspects of this topic to discuss and even these I will have to cover but briefly. What I really hope to do is to focus upon parts of this topic, that is, how the emotions affect thinking, in a way that may give you some ideas that might be useful in the classroom. The ideas I will present stem from what we know about the thinking processes through evidence obtained both empirically (clinically) and experimentally.

To begin let us take a quick look at how emotions affect thinking. This in itself could be quite an abstract and theoretical subject. I will present only a few ideas that might perhaps stimulate some ideas of your own on what should be a proper emotional environment for learning. To begin with, I think we all might agree that feelings of well being, of personal worth, of self-reliance, of belonging and being successful are part of an optimal emotional adjustment. It follows, and I believe that all of you would again agree, that optimal emotional adjustment is a fundamental prerequisite to optimal intellectual functioning. What we are saying is that an individual, to be able to think clearly, for his intellectual processes to function smoothly and to be openly receptive to new ideas, needs to be relatively free from anxiety, to be able to accept and deal with his impulses in an acceptable manner and to be free, as much as possible, from the types of neurotic defenses that bind our mental energy to such an extent that we do not have the resources left for truly productive thinking. We need to be relatively free from the kinds of neurotic defenses that make us fear the unknown, that force us to cling to crippling prejudices and confine us to thinking in rigid, stereotyped ways rather than being capable of free and divergent thinking. Anxiety, as you know, is generally precipitated by real or imagined threats to the ego--to the person's self-system. An excess of anxiety leads to disruption of normal thinking processes; to rigid, stereotyped thinking. It also sometimes leads to living in fantasy as well as to a whole host of what are called mechanisms of defense. The defense mechanisms are designed to attempt to reduce anxiety and often lead to more or less neurotic symptoms such as anti-social acting-out behavior, overcompensation, repression, displacement, and so on.

I am sure these ideas are not at all new to you but perhaps a brief review of them might stimulate your thinking and remind you of some aspects of mental life, perhaps forgotten in the press of daily work. If I may cite an example from my own work: I am constantly reminded of the effects of the emotions on the thinking processes in testing. Many of you are familiar, at least to a degree, with the Wechsler Intelligence Scales. These particular intelligence tests, for those who are not familiar with them, are broken down into a verbal and a nonverbal scale and both of these are further subdivided into subtests measuring important but somewhat different facets of the intellect. I often see children who are referred because of a poor response to school. Rather frequently I find that on the Wechsler Scale, the most abstract of the subtests and those correlating most highly with general intellectual ability may be at a normal or better level but those subtests requiring attention and concentration may be depressed to a severely retarded level. This, of course, tells us in many instances that this person has a very normal intellectual potential but that his ability to think clearly and to deal with problems is being disrupted by the anxiety precipitated by emotional difficulty. Also, when I see a youngster who is very much ill at ease in the testing situation, appears quite tense, is inhibited, reluctant to admit he does not know the answers to the items to which he really does not know the answers (despite the fact that I have done my very best to make him feel at ease), then at this point I speculate that this youngster's ability to perform is crippled by anxieties stemming from feelings of inadequacy and a lack of self-confidence. To be asked to display his abilities in front of another person is extremely traumatic. This type of person despite his potential is not going to do very well, obviously.

I cite these evidences of anxiety and its crippling effect on an individual's ability to think to give an example as to how this phenomenon is apparent in my own work. I am sure many of you could cite examples of this same problem observed in your daily work. Surely you have seen students block completely when called upon, students of apparently good ability not being able to learn even with individual help, the forgetting of the obvious, and so forth. I don't believe there is any quarrel among us that the emotional state of the individual has a tremendous impact on a person's ability to think and therefore to learn.

Because most of you are teachers I would like to focus now upon some ways in which the teacher might produce anxiety in the classroom and therefore restrict the student's emotional freedom to learn and also to cover some general principles which might be an aid to you in reducing the student's anxiety level and therefore promoting the emotional freedom to think and learn. I don't want to get your hopes too high because we won't be able to go into this very deeply or at length, but I do hope some of my remarks may be significant and stimulate you to apply your knowledge of learning, thinking, group dynamics and child development to do some serious reflection and perhaps some creative thinking about your classroom techniques, especially the presentation of material and discipline. I sometimes feel that the particular area covered by my subject is rather neglected in teacher training and more lip service is paid to it than anything else. All this seems to be true in the supposedly enlightened age where the principles and concepts of good mental health are thought to be widely understood.

Let us now take a brief look at some factors that influence the emotional atmosphere of the classroom. The teacher as the mature, guiding and well-trained adult provides the emotional tone of the classroom through his methods of presentation, the limits he sets, his methods of discipline, and more subtly through his basic attitudes toward people in general and toward his students in particular. In other words the emotional adjustment of the teacher, that is, the teacher's own personality as reflected through his personal security, the strength of his ego, his own receptiveness and freedom to learn and his ability to relate to others in a healthy and meaningful way as well as his own freedom to think divergently, is one of the most important variables in that classroom. Certainly this is as important a variable (if not more important) as the variability in native ability among his students. However, I feel that in many instances educators feel otherwise. Perhaps most of you are familiar with competent investigations demonstrating that children learn most efficiently when the classroom atmosphere is relaxed, friendly and permissive. It is difficult for me to see how a classroom atmosphere can be relaxed, friendly and permissive when an irascible or perhaps tired teacher may scare the very devil out of the students when he, for example, is forced to discipline a child and then does so out of almost uncontrolled anger.

I think that we would all agree that discipline should be of such a nature as to help children to learn. In other words, it should be part of the learning experience and should be constructive rather than destructive. Therefore I would state that one principle of proper discipline is that it should be given in a calm and unemotional manner to be most effective. Discipline should be directed toward teaching the student that this certain type of behavior is not acceptable and that it is not the student himself who is unacceptable. I believe there is some truth in a statement to the effect that one who consistently perceives someone else's behavior as directed especially toward himself and who becomes very angry or defensive about this, may not be too well adjusted personally. Now to look at the other side of the coin: The teacher who feels he must be a friend to everyone in his classroom and feels he must gain the love of every student in that room and who further feels that any attempts at discipline or control will defeat these purposes, is none too healthy an individual himself and is really doing his students a great disservice. There is no conflict between us to the extent that we agree that limits and self-control are needed in the classroom just as they are in almost every other situation where human beings are together in our society. There is no doubt that discipline or disciplinary action is sometimes called for. There is quite naturally behavior that cannot be condoned in a classroom. However, what I want to stress at this time is that one must choose intelligently the types of discipline he is going to use and the kinds of limits he is going to provide. I would stress that limits are necessary, especially for children. They are not only necessary, for example, so that we keep them out of the hair of adults, but they are necessary to normal development and to the good mental health of the child.

Children who know no boundaries, no limits, no controls, are frequently very disturbed children. Perhaps some of you can recall in your own experiences cases of children whose parents provided little in the way of limits or direction for them. We find that these children often act-out quite badly in trying to test the limits or seek the boundaries in order to find something on which to grasp hold in a confusing or unknown world and to provoke some kind of involvement on the part of their parents. The same is true in the classroom. Children need limits to know what is expected of them. I know that in most classrooms limits are very definitely provided. What concerns me in this chapter is the fact that in some cases there are many violations of good mental health principles occurring in the area of setting limits and disciplining children. Quite frankly, I often do not know what can be done about this except to discuss it every chance I get. Most of the time the way a teacher reacts to the students in his classroom, or especially the way he disciplines, is very much a reflection of his own personality and for the most part the possibility of deep personality changes in these individuals is pretty remote.

Let me now cite some examples of rather poor discipline out of my own experience. I don't spend a great deal of my time in school buildings but on several occasions when I have been in buildings, I have been made very much aware of some teachers who literally scream at their students all day long. I would assume that there are just a few students in the room at whom this screaming is directed most of the time, but the other children in the room must suffer also, if only because of the high noise threshold. I am sure, however, that they suffer in other ways as well. I cannot help but be curious about the adjustment of this kind of teacher and wonder if she is really happy in her work.

I also have been made aware of a not so uncommon practice where because of the misbehavior of one or two children in a class, the whole class has been, for example, kept after school or prevented from going out for recess or going to gym. This type of discipline must be considered very unfair and unjust by the innocent. It reminds me of boot camp in the Marine Corps where this type of thing was done quite frequently. A whole platoon would be put through rigorous exercises and maneuvers, say at three o'clock in the morning, because one person in that platoon broke a rule. I imagine part of their rationale was that the other members of the platoon would take care of that person later. In the Marine Corps this was an appropriate type of discipline because the goal was to teach this group of forty-some men to act as a single unit in combat and to demonstrate that if one man fouled up on his job, he could endanger the rest of the unit. However, although we require a certain degree of conformity in school, the goals are not quite the same as those of training a Marine Corps rifle platoon. The goal, I believe, is to encourage divergent rather than convergent thinking and to encourage uniqueness rather than blind conformity. So in the classroom, the type of discipline just mentioned is very inappropriate.

We previously mentioned that the classroom atmosphere should be a permissive one. Let's briefly take a look at this question of permissiveness versus authoritarianism in the classroom in a general way. The permissive classroom is not one in which there is no discipline nor one in which the teacher surrenders his role as a mature guide in classroom management. It is a classroom where each pupil is free to live and work as a member of his peer group and at the same time enjoy the guidance of an adult whose character is not that of a rigid authoritarian leader but that of a mature and responsible person entrusted with encouraging the growth of less mature people. The idea is that the teacher and the student plan together so the student's growing ability for self-direction is encouraged rather than thwarted by teacher-made decisions. Discipline in the permissive classroom consists in the assumption of responsibility on the part of the student and in setting limits for his conduct as a member of the group as well as for the group as a whole with respect to their school community. Incidentally, I believe these are good general principles for parents to follow also in considering child rearing techniques.

To get back, schools permitting a maximum of self-direction and responsibility in the classroom are helping the student to build the inner controls he needs to function on his own as an adult. I refer to the mature adult who does not need constant brushes with the law and other social agencies to keep him on the straight and narrow. On the other hand the authoritarian teacher creates difficulties for the developing child and fails to encourage self-direction. I think we can say for the authoritarian teacher, just as we can for the authoritarian parent, that he forces a child into a situation of dependency, provokes feelings of inadequacy by taking decision making out of his hands and not allowing him to develop responsibility for his own behavior. In many cases I think the authoritarian character is a rather cold, aloof person at whom the psychiatrist might look and say he probably lacked the experience of loving and being loved; he frequently tends to regard other personalities, even the personalities of growing children, as threatening to him. This type of person, instead of teaching self-discipline, teaches a child to depend upon authority, to accept imposed discipline so the individual does not develop controls within himself so necessary to maturity. Certainly this is not the goal in a free society such as ours.

Important to teachers as well as parents and for that matter anybody else who deals with children are two principles in the guidance of children toward mature thinking. First, creative imagination needs to be encouraged and cultivated. This in early life is essentially one of the major jobs of the parents. Secondly, this imagination must be enlisted in the solution of realistic problems in the world of everyday living. This becomes a responsibility of the educator as well as the parent. We all know that in the healthy child, vivid imagination is joined to a very keen interest in the world about him. A healthy youngster is experience-hungry. He will observe many things with great eagerness. However, his ability to reason competently is conditioned by the range of his previous experiences and by the degree to which these experiences challenge him to reflect upon them. I cite this because in my experience a common demand made by teachers and parents to a youngster is, "Now think." We wonder why this encouragement frequently falls flat. No doubt it is because the children haven't the facts with which to answer the question posed to them, or they cannot see the problem and therefore cannot appreciate that the question has any point, or they have been so seldom asked questions which they could answer on the basis of fact that they haven't developed the ability to reason. To a child, then, the whole thing is in the teacher's or the parent's head. It would be unrealistic to think that a whole school curriculum can be built around problems that are always real and vital to all students. However, teachers and parents who understand the needs of developing children can inject at least a measure of reality and vitality into their classroom or home methods. The old saying, "We learn by doing," holds in problem solving behavior or reflective thinking as in all other activities. We learn to solve problems by solving them and we learn to reason clearly and carefully by practicing reflection.

I believe it is the task of the adult who is guiding individuals or groups of individuals to learn to solve problems to determine what level of difficulty in problem solving is suitable, and thereby avoid frustration and resulting anxiety. The leader of a group of school children assesses the capabilities of the individuals in that group and if he hopes to develop the thinking capacity of each child, sees to it that a variety of problems ranging from the more abstract to the quite concrete rise in the course of their class activities. There is a big difference between real, honest-to-goodness experience on the part of the class and the artificial sort, only too common even now, in which no one sees the problem except the teacher and everyone drags through the teacher-directed steps towards solution. The role of the teacher as I see it, or that of any other adult who is guiding children in the development of thinking, is first to provide a warm, permissive, and understanding atmosphere in which to learn and then to confront the children with genuine, realistic problems within their capacity to solve.

Before closing I would emphasize that no one is more aware than I that there is no way one can tell a person how to respond in every situation and no one has a cookbook that can tell you how to discipline or how to conduct your classroom. Each new situation requires a decision on your part as it arises. However, if some of what we know about emotions and thinking is kept in mind when we have to make these decisions, then I feel our decisions and judgments will be that much better.

Children come to school from varied backgrounds, with various personalities, and therefore run the gamut from very good adjustment to very poor. However, I would not underestimate the teacher's impact on any child no matter what his previous adjustment. The elementary teacher has a child in the important formative years, but the junior high school teacher has the student in early adolescence when the overthrow of parental goals and ideals, and the search for new goals, ideals and identity really begins. The teacher is one of the ego models constantly before the adolescent and therefore a highly important person in his life. I believe if one could dissect an adult in this society to see whom he had patterned himself after, one would find parts of several of his teachers.

It is my hope that in this brief paper I have given you some food for thought on the impact of emotions on thinking, and the teacher's role in this area. I also hope that what I have written may cause some of you to reflect upon your own methods in the classroom just a little. If I have done either, I will feel the paper has been well worthwhile.

SEARCHING FOR ANSWERS

Richard F. Powers

A great deal is being written today about the rapidly expanding boundaries of man's knowledge. One new discovery leads to many new discoveries, and we find our accumulation of facts advancing in geometric progression. Although children learn from their total environment, it has been traditionally the role of the school to pass man's knowledge on to the younger generation.

Facing this formidable task has led many educators to ask themselves serious questions. How can the school accomplish this? The longer school day, the twelve-month school year, longer compulsory education, and even the fifth year in college are all centered around the idea of exposing the individual to more formal training in the schools. I do not question any of these proposals, but if they are answers, they provide only a temporary solution, for man's knowledge will continue to expand, and the school must eventually face the problem of "What shall we teach?" and "How shall we teach it?"

Our teachers usually give generalizations and explanations to pupils directly as part of the didactic expository approach, or they may present material in a sequence that directs children in a desired area toward goals that the teacher has preset. In other words, the teacher has certain materials she feels are important, which she presents to the children for them to retain in their memory for later recall. Thus, many of our classical studies in the psychology of learning deal with memory, retention, recall and forgetting. These studies show that it is inefficient to learn facts that cannot be recalled later, that are forgotten, or that are incomplete.

We are coming to realize that it is more important to help a child learn how to find the answers in a logical and efficient way. It is better than asking the child to memorize long lists of facts, dates, and symbols. Consequently, the most practical research in learning theory today is centering around the process of thought, discovery, reasoning and inquiry.

One of these projects is being conducted at the University of Illinois under Professor J. Richard Suchman. This work is being sponsored by the Office of Education, U.S. Department of Health, Education and Welfare, and by the Research Board of the University of Illinois. This project is known as the Illinois Studies in Inquiry Training, and is devoted to the development of techniques for strengthening the inquiry process in school children. This work has resulted in the development of materials and procedures that can be used by the classroom teacher to develop in her pupils the ability to create individual knowledge by gathering and processing information. Present materials include a teacher's manual and student handbooks using physics, physiology, and economics as a content vehicle through which the method of inquiry can be learned by students. A series of short films are used in each of the three areas in order to present problems for the students' analysis.

Briefly, the inquiry training approach is to present a problem to the students on film, and then allow the children to try constructing explanatory models or theories of causation. They may obtain additional data by asking questions which are answered by the teacher immediately. These questions must be phrased in such a way that the teacher can answer them with a "yes" or "no." In this way the child is discouraged from transferring control of the process to the teacher. This would be relinquishing their roles as inquirists, by returning to the traditional dependent role of listeners and memorizers. The children use their questions to verify events or material conditions depicted by the film, or to conduct imaginary experiments. They analyze the conditions of the event, and the properties of the objects or of the systems involved. The children are responsible for the analysis and for the construction of explanatory models. The entire process is carried on verbally, and the teacher can observe the process as each child develops his own individual approach to solving the particular problem.

INQUIRY TRAINING

Sybil Carlson

The Inquiry Training Project, directed by Dr. J. Richard Suchman, at the University of Illinois, was initiated to fill a need in the educational curriculum. Much of the elementary school curriculum today is focused on the direct teaching of generalizations and conclusions. Our content consists of the conclusions which have been formulated in advance by scientists and scholars. Children are looked upon as the consumers of this knowledge, rather than allowing them to become involved in the process of formulating conclusions themselves. The "right" answer has become so paramount that children are not given the opportunity to process data, to build and test theories, and to create knowledge themselves.

Thus we are producing dependent learners who have lost faith in their capacity to inquire. Instead of exercising their initiative and autonomy in the learning situation, children learn to shift to dependency on authority to tell them what is right and what is wrong. This dependence continues to be rewarded whenever the child comes up with "right" answers.

We believe that empiricism is a characteristic of children and that it can be fostered within certain optimum conditions. When conditions in the classroom prohibit autonomous learning from taking place, we create dependent learners who must rely on a learning process which is restrictively programmed and directly controlled by the teacher. The teacher and the traditional educational setting direct the development of concepts toward predictable levels of conceptual organization. The children may arrive at some understanding in this way, but they have been deprived of learning how to think, and of an understanding of the nature of knowledge. For some years it has been recognized that teaching children to think is an important educational goal. Before this goal can even be approximated, however, we need operationally to define the process of inquiry.

We need to ask, and to investigate

What kinds of operations are involved in thinking?
Is thinking just a matter of coming up with answers to questions?
Is thinking just solving problems in mathematics, or writing a composition?
What are the elements of thinking?
What conditions in a classroom serve optimally to promote autonomous learning?

Illinois Studies in Inquiry Training has continuously been attempting to gain insights into questions such as these. The first large-scale project in Inquiry Training was conducted during the school year of 1960-61 in 12 schools throughout the country. A series of 36 physics films were developed especially for this research. For 24 weeks trained teachers in each school directed a sixth-grade class in Inquiry Training while a control class was also covering the same subject matter. This study contributed additional insights into the inquiry process. A final report of this study is available in detail.

Following the 1960-61 project, more materials were developed in physics, and in the new content areas of economics and biology. Systems for the analysis of the inquiry process were further revised in the light of considerable data. Teaching techniques were also altered and more adequately delineated. These efforts then contributed to the study which has just been completed during the 1963-64 school year. Sixth-grade children in five Urbana schools were randomly divided into four groups per school. For 8 weeks, two of these groups in each school received Inquiry Training in physics from members of the Inquiry staff, while the other two groups were taught physics by the regular classroom teacher. During the subsequent 6 weeks, one group in each school that had been trained in Inquiry was taught economics by the regular classroom teacher, the other Inquiry-trained group was allowed to inquire about the same economics problems, using an economist as their source of data. The third group in each school, not having received Inquiry Training in physics, was allowed to inquire into economics with a resource teacher. The fourth group remained in an expository setting throughout the study. The same groups and design were employed in biology. All subjects, approximately 300, were extensively pre- and post-tested. The data are now being analyzed, and a final report will soon be available. This study was an attempt to measure the transfer of inquiry skills from physics problems to economics and physiology problems.

Now we are engaged in a demonstration project that is supported by the U.S. Office of Education, and this project is what I shall discuss here. Ten two-man teams were selected from applicants throughout the Midwest, and were trained in an intensive 4-week institute at the University of Illinois the summer of 1964. The teams are now conducting Inquiry Training in their own classrooms, and are expected to introduce it to educators and the public, and eventually to train other teachers and administrators who desire to incorporate Inquiry Training in some form in their classrooms. By this means, Inquiry Training can be made available to many more educators than would be possible if we continued to direct all efforts from the University of Illinois. Hopefully, this plan will bring inquiry into the educational scheme.

Before I explain our concept of the inquiry process, let us just contrast it to two other forms of the "discovery" approach. Actually, the term "discovery" has come to mean a variety of different approaches, and has thus become unclear and controversial. As you know, Dewey and his followers prescribe putting the child in a predicament and then letting him find his way out; this kind of situation gets very frustrating for many children, particularly if they don't have the tools to work their way out of certain problems. The use of a predicament provides excellent motivation, but the lack of structure is frustrating. People want and need some guidelines and limits.

Another form of discovery is what might be termed "programmed discovery." The children are given problems to work on that are sequenced in such a way that eventually the children arrive at the underlying concept. This technique does allow the child to attain a concept inductively and at his own pace, but it is still not developing inquiry skills as we see them, since the decisions as to what information comes next are still the decisions of the teacher.

Our approach to the development of inquiry skills is quite different. Essentially, we do two things. First, we try to create what we have determined through experimentation are the essential conditions for inquiry to occur in the classroom. Second, we attempt to help the child verbalize the inquiry process, so that we can begin to analyze the process itself, irrespective of content. We ask,

> What kinds of operations are you performing when you inquire; what is your goal?
> What does it mean to explain something?
> What does the answer to the question, "why?" mean?

In order to meet these two primary objectives, we feel that three necessary conditions for inquiry must be provided:

1. First, there must be some kind of focus. It is not sufficient merely to draw the attention of the child. We have found that inquiry is stimulated in the classroom by a discrepancy, that is, when a child senses a gap between what he knows and the event he perceives, he feels the need for additional data. Besides providing him with an objective, the discrepant event proves to be highly motivating.
--We create discrepancies through our films, through problems which the teacher poses, and by encouraging the children to recognize and create their own discrepant events.
--Our series of 36 films touch upon the areas of physics, economics, and biology. Each film presents a brief discrepant event that challenges the children to inquire. Thus we have condition #1, focus.

2. Condition #2 is freedom, the most important element to stimulate and sustain inquiry. There are two kinds of freedom that we attempt to provide--external, or environmental, freedom, and internal freedom.

    By external freedom, we mean that the child is allowed to operate in a way that he wants. In other words, he is permitted to reach out for the kinds of information he wants, whenever he wants, and in whatever sequence he wants, as freely as possible. The child is encouraged to try out any idea--should he express any idea whatsoever, it is recognized as his and he is free to try it out. No one laughs at what appears to be a crazy idea, since we encourage trying out a hunch. No one is told that one idea is better than another. Each idea is treated equally, whether it is brilliant or ridiculous.

    The internal component of freedom is psychological freedom or autonomy, the willingness on the part of the child to take advantage of his external freedom. Many times you can place children in this external freedom, but it isn't really freedom unless the children are internally willing to take advantage of it.
    --It takes longer to create internal freedom.
    --One of the necessary elements of internal freedom is to permit external freedom.
    --Once the children see that they are free to process information, they gradually acquire a greater sense of intellectual potency.

--If the child feels that he has power in exploring his problems, he eventually discovers that the world really has some order to it.

--In essence, he begins to participate in the building of knowledge, and this has a tremendous motivational effect.

--As the children inquire autonomously, the teacher helps them to develop their own criteria for the testing of theories or ideas. Theories and ideas which have been created by the individual child to match the data that he perceives are more meaningful than if externally imposed.

Thus Condition #2 is freedom, external and internal.

3. The third necessary condition is a responsive environment. As the child is reaching out for something, there had better be something there for him to get. If he wants to ask questions, his questions need to be answered. If you are going to let him manipulate or experiment with his environment, his environment must be responsive to him.

- --It doesn't have to be a controlling, directing environment.
- --The inquiry teacher is to some extent selectively responsive:
  - --The child will obtain a direct answer to data probes.
  - --Questions about theories, or ideas, are recognized and accepted, but the child himself is challenged to test his theories and to develop his own criteria for testing them.
  - --Involvement becomes even more motivating than getting the answer.

These are the three conditions--focus, freedom and a responsive environment. Let me tell you how we translate these conditions into an Inquiry Training session. This is just one approach to translating these conditions into action. The discrepant event is posed in a film--either in physics, economics, or human physiology. The film shows an event that is startling, surprising, the real event (no magic). The problem is to find out why--to construct some kind of theoretical framework that will enable you to explain this event in terms of natural cause. There is your focus.

Here is freedom--the children can ask questions. We do set some limits. They can ask only questions that can be answered by "yes" or "no." If we permitted them to ask any questions, the first question would be "Why did that happen?" We don't want to slip back into the role of explaining--the inquiring and explaining is in the hands of the children. The role of the teacher is to answer questions, and to shift the children from their roles of dependency to independent inquiry.

> The child can see something he doesn't understand, and can sit back and ask "Why did that happen?" He's really saying, would you please take over and tell me. I don't really want to make the effort to analyze this problem or to try out any of my ideas. That's a pretty lazy approach, a dependent approach to learning. The physicist can't walk into his laboratory, address his lab bench and say, "Explain physics to me." He has to make his

problem talk by manipulating it, by setting up experiments, and by thinking. He has to be an active learner. The "why" approach is a passive form of learning, unless you take your own question, "Why?" and begin to work on it yourself.

Another rule we set is that the children can ask as many questions as they want to in a row. This permits freedom, and also allows the child to plan sequences or strategies of inquiry.

The responsive environment is the teacher--this means that the teacher has to know what he is teaching, and must be able to respond to the individual child's conceptual growth. In order to inquire, the child must not only have these conditions, but also a store of ideas, a conceptual model, to organize data. Some children already have a wealth of conceptual models and are able to use them to decide what information they need. Others have only a few models, and are inhibited in their question-asking. Thus we allow the children to have a conference and the children can pass ideas along to each other. They can also acquire conceptual models through hearing other children asking questions, posing and testing theories.

Our ideabooks in the three subject matter areas also serve as a source of questions. These books do not give the "answers," but serve rather to stimulate further questions.

Another point which I need to make is that the Inquiry Training program does not attempt to teach subject matter. Instead, subject matter is used as a vehicle to aid in the development of inquiry skills. We have found that the children do learn much about these subjects during their inquiry, but this is an additional benefit. Our goal in inquiry is to promote autonomous thinking, and to help children to build and test their own theories.

Later in training, once the children become comfortable in the conditions of Inquiry Training, they begin to discuss and gain an awareness of

what theories are,
the functions of theories,
where theories come from, and
how to evaluate theories.

The children begin to do these things intuitively, and as they do, the teacher attempts to help them to recognize their behaviors, and then to classify them. They begin to use a rhetoric of inquiry so that they may abstract the inquiry process from the specific problems, and can apply these skills in further searches of their environment.

THE "INQUIRY TRAINING" PROGRAM AT MOHAWK SCHOOL, PARK FOREST, ILLINOIS

Wesley Pruitt and Franziska Naughton

In the fall of 1964, two inquiry training classes were organized at Mohawk School. A class of fifth-grade pupils led by the teacher meets once a week. Each period is approximately one hour in length. The sixth-grade students forming the other class are taught by the principal and meet a comparable amount of time. Fifteen students were selected for each of the two groups on the basis of teacher-recommendation, general achievement scores, and ability test scores.

The pedagogical techniques involved in Inquiry Training consist of presenting a discrepant event on film to a class. The pupils are encouraged to build a conceptual understanding of the event through acquiring certain kinds of information needed to complete, or provide, an acceptable theory explaining the event. No extrinsic reward or punishment is offered by the teacher. Premature theories are turned back to the class to examine in terms of the power to predict, with such questions by the teacher as: How useful is the theory? Does it explain only this situation or event?

One aim of Inquiry Training is to shift the responsibility and process of thinking from the teacher to the student. Typically, students depend upon the instructor to answer their questions in a relatively complete fashion. Such a procedure encourages students to limit their questions to those that are "acceptable" to their classmates; that is, the questions may not be pertinent to the answers actually needed, but often are devices designed to raise one's intellectual status within the class. A climate conducive to anxiety-free questioning and thinking at the existing level of understanding of each individual is developed in the Inquiry Training classroom to help attain this end.

In the "Inquiry" classroom climate, students are permitted to ask questions about a problem which can be answered with a "yes" or a "no." Both the fifth- and sixth-grade students have experienced some difficulty in limiting themselves to this type of question. Quite a bit of frustration occurred during the first few months when many questions were answered with, "That is for you to decide," or "Could you be more specific?" Periods of silence were especially common then, too, as the students tried, consciously and unconsciously, to get the teacher to be more directive and to assume the "expected" role of the teacher. Psychological pressure forced the pupils to retain the responsibility of thinking but the freedom and power that should accompany it have not been fully realized.

The security in one's habits of learning in a basically teacher-oriented classroom has proven difficult to dislodge. Too often, during an inquiry session, are the pupils satisfied with a relatively superficial explanation of the problem presented. The concept of using a theory to predict events when certain conditions are varied has been especially hard to grasp. Few of the pupils knew in December how to acquire additional data by experimenting through changing the conditions within the system.

Since understanding the questioning process is essential if inquiry is to become a useful tool, there is cause for some concern with the reluctance of fifth- and sixth-grade pupils to take advantage of the greater freedom actually provided in inquiry sessions to pursue information necessary to develop more useful theories. Even so, there is progress. The frequency of questions has increased markedly since the first session. There are fewer direct efforts to obtain the "answer" from the teacher, and pupils, in general, are beginning to make fewer explanations and theories that are based upon false assumptions which in turn depend upon the need for additional data or facts.

Students leave the class with no solution advocated by the teacher. The lack of closure on the part of the teacher has been disturbing to both classes, but the emphasis must be placed upon the process of inquiry rather than upon problem solving if pupils are to acquire or develop an awareness of the value of inquiry techniques. Usually the pupils do form theories which satisfy themselves before leaving the classroom and in some instances become too complacent about the inadequacies of their theories.

Each session is critiqued by the two teachers. Particular attention is paid to the sequencing of questions by individuals and the class as a whole. Teaching techniques are questioned and revised if they do not appear to contribute to the objectives of the program. The degree to which each pupil participates is noted and the outcomes of the class "conferences" are assessed.

The most obvious benefits of Inquiry Training have been to the teacher. There have been several regular classroom practices which have been altered because of the increased sensitivity to what the pupils were really trying to accomplish when asking questions. Repeated questions are treated more tolerantly. Incorrect or different answers by pupils are received with greater patience and understanding. In effect, the classroom tends to shift from the teacher-oriented pole to the pupil-centered orientation. Behavioral changes of teachers of this nature are highly desirable and are certainly valuable outcomes of Inquiry Training. Any procedure which lessens the anxiety that prevents free communication between the pupil with other persons in the classroom also provides a condition necessary if improvement in inquiry techniques is to take place.

At the end of the 1964-65 school year, a terminal evaluation of the Inquiry Training Project will be made. The features that are found to be useful to teachers and pupils will be identified and retained in the District. Workshops and other in-service programs are to be used in transmitting the theoretical implications as well as the more practical considerations of inquiry development throughout the school system.

INDUCTIVE METHODS OF TEACHING IN JUNIOR HIGH SCIENCE

Maurice A. Kellogg

The wide usage of a word often confuses its meaning and leads to the addition of qualifying phrases or to the use of alternative terms. Thinking is such a word. Critical, reflective, productive, and creative are such qualifiers. Problem solving, scientific thinking, scientific method, and inductive approach are much used alternatives, each having presumably different but unclear shades of meaning.

Dr. Harold Anderson, Research Professor of Psychology, Michigan State University, speaks of the inductive approach as the "Open System." He points out that the "Open System" is a stimulating system of relationships which accepts uniqueness in perception and thinking. Familiar examples of the "Open System" in education are found in the seminar, class discussion, term paper, original experiment, or student project. The "Open System" permits originality, experimentation, initiative, and invention, and is most productive in the years before the pressures of set curriculum patterns and systematic teaching. The "Closed System" is concerned very little with originality or invention by the student. It is concerned mainly with acquiring a body of knowledge, memorizing facts, and finding answers to problems--all of which are already known to someone else. Dr. Anderson further states, "Almost all of our traditions and psychological theories about learning and problem-solving have been obtained from 'Fixed-Answer' or 'Closed System' experiments. Rewards and punishments and 'avoidance learning' in animals or in human beings, have defined goals and patterns of research design set in advance by the experimenter. They are excellent for the kind of obedience learning so important in dog training, but they do not produce the 'Open-System' creativity found in humming a new tune, writing a poem, or making a scientific invention."

Dr. Robert Karplus, Project Director, Elementary School Science Project, University of California, states, "We felt that the long-standing benefits of science education consist of an understanding of the fundamental generalizations of the various fields and of the practice of inductive and analytical thinking that construction or discovery of these generalizations entails. It is, therefore, the task of the teacher to introduce the materials in such a way that they will serve as a path to the ultimate conclusion rather than becoming and remaining ends in themselves."

Inductive learning is the realization of the science concept through observation of the concept in action. The concept is derived through personal experience and involvement, perhaps not only mentally, but physically. In the deductive approach, presentation of the concept is followed by extensive application and illustration, working from the generalization to the specific.

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Children can learn and infer from their own observations. The effect of emphasis on critical thinking or the scientific method in particular courses has been studied, and the results in many cases have been positive and have shown improvement over classes taught with more traditional emphases. Usually, the increase in knowledge is equal to or greater than that found in classes taught with content emphasis. The extent to which this increased ability is more broadly applicable to problems in other courses and in life is less certain, for no example of concentrated attention to the objective throughout an entire curriculum over several years has been reported. Nevertheless, the conclusion that students can learn to think more critically if appropriate instruction is provided seems to be justified.

If we accept this premise, then how do we implement such a program into our science curriculum? There seems to be a compulsive desire on the part of some teachers and administrators to discover THE science curriculum. Adoption of a curriculum guide, whether it be an original one or one modified from other successful science departments, is purported by some to be a panacea to all of science education "ills." We cannot permit ourselves to fall into a false sense of complacency but remember that the curriculum is only as effective as its implementation by the individual teacher in each classroom. Equipment and facilities subsidized through NDEA, a pat science curriculum, and the presence of a teacher do not insure a successful science program. The teacher must have some freedom of decision and action in the formation and implementation of the experiences which form the bulwark of the curriculum. The "science guide" must not be a rigid barrier to a teacher's own initiative and ingenuity.

The science teacher needs to promote learning by creative opportunities for individual experience and achievements. Learning does not start with formal education; it begins when a child first starts noticing the world around him. We are all learners when we investigate changes and relationships of things around us, and our natural curiosity enables us to learn at a rapid rate. However, curiosity is dampened and adventure turns to toil when concrete exploratory experience is denied the learner. We might say, then, that the success of our science program is the degree to which a science teacher can promote and sustain within each individual a curiosity, an interest in discovery, and a sense of achievement in establishing relationships in science. Adequate facilities, equipment, textbooks, and curriculum guides are necessary means to this end but are certainly not ends in themselves.

Critical thinking must start with a problem which holds some interest, which is within the ability of the students, and for which the students may not know the answer. In some cases students may know the answer since knowledge today is easily accessible via T.V., reading, and so on. Students often come to a science class today with knowledge of an answer, but little knowledge of the "science" behind that answer. The inductive approach provides the means to the end, and once the answer is achieved, the student is often surprised to find what is entailed in arriving at that "answer." He learns to appreciate the problem as a scientist originally had to explore it. Can we go so far as to say he develops a thinking procedure comparable to that of a scientist? Problems may arise by chance from student experiences in or out of the classroom or they may be "planted." Relatively simple problems for which explanations are easily found must be followed by more difficult ones wherein the student learns that even errors and false leads may be productive if only they are viewed in the proper light. As students come to grip with these problems, their experiences should include devising experiments, collecting data, making guesses, and checking for accuracy as they cultivate methods and attitudes conducive to effective learning in the field of science. Students are also encouraged to consult reference books and to interview people who are thought to know something about the problem under study. Later, students are encouraged to select and to restate, with proper caution, what appears to be their best hypothesis and to use it in attempts to explain phenomena.

Let's take some random science problems as examples and consider an inductive approach that might be employed. The examples I am citing are ones that we have actually used this year in our eighth-grade science classes at our Campus School.

A. THE PENDULUM:

Without any experimentation the youngsters were asked to list the factors which determined the period of the pendulum. A typical example of the factors listed by the students includes length, size of string, weight of the bob, distance drawn back, initial force applied to the bob, gravity, air resistance, wind, and volume of the bob.

They were then asked to suggest a method for measuring the period of the pendulum. Many attempted to time only one vibration, but as the work proceeded, it was soon recognized by all that a better procedure was to time several vibrations and then determine the period. One youngster noted that he and his partner didn't always agree on basically the same measurement; thus, it was soon established that many measurements were necessary in order to obtain a good value of the variable under study.

The youngsters were then asked how they would determine which of the variables listed above, and any others that they might have, affected the period of the pendulum. In rather crude terminology they came up with the idea of the controlled and variable factors in an experiment. After collecting their data and making the necessary calculations (here they were required to number their calculations to correspond with entries in their data table), they were asked to analyze the data to determine which factors were involved in the solution of the problem.

Without exception, length was listed as a factor; a few papers included amplitude as being a slight factor; and one youngster thought he could detect a small difference due to air resistance. (He set up a small pendulum in a bell jar.) Some predicted gravity but didn't know how to measure it, but no one missed the test question which asked how the period of a pendulum on a rocket ship high above the earth would compare with that on the earth.

B. THE CANDLE:

A burning candle offers many opportunities for critical thinking, designing experiments, collecting data, and drawing conclusions. We can consider the seemingly simple question, "What is burning?" and others such as "What are the necessary requirements for burning?" "What are the products of burning?" "Does the wick have to be combustible?" "What are the properties of a good wick?" "What is the hottest part of the flame?" Each question poses a problem to be explored, or in many cases one problem leads to many more unanswered questions. It is gratifying to observe as they discover that it is the wax vapor that actually burns, that an asbestos wick works, and that they can get indication of the hottest part of the flame using their own homemade thermocouple and a galvanometer. After a great deal of thought and many constructive criticisms, tempered with much patience, students begin to see that to prove that a candle needs oxygen requires controls with variables reduced to one. As a result of our candle study, the students have become acquainted with concepts of several areas of science including chemical change, physical change, and thermal-electricity.

C. SYSTEMS OF MEASUREMENT:

The youngsters were asked what qualities a unit of measurement should have. Those listed included consistency, accuracy, and familiarity. After a day in the lab a fourth, ease of handling, was added as a must to the list.

With the first three factors in mind, the students went into the lab where they were asked to measure the area and volume of various sized objects. They were given no measuring instrument. Within a short period of time a mass of new units appeared: the eyebrow, the nose length, the finger width, the ring width, the spiral, and the youngsters were busy computing volumes in square and cubic monstrosities. They were then asked to convert their units to a large unit, such as three and a half eyebrows make a hand, and then determine their areas and volumes in terms of their larger unit.

Back in class we discussed the English system and its merits which they soon concluded was not much better than the system they had developed after computing the number of cubic miles in a block of wood 2 inches on a side. At this point ease of handling became an important quality of measurement, and the metric system was introduced. Back in the lab they repeated their previous measurements in the metric system taking only one set of readings in centimeters and converting easily to the other units. After the previous struggle the metric system was a happy relief which they mastered quickly by expressing sizes of familiar items in terms of the new system.

It will be noted that the above topic is of a very traditional nature, but in presenting it the student is not told what to expect nor is he asked to memorize a certain amount of factual information. Instead, he is allowed to pursue the topic by getting involved in it, making suggestions, examining these suggestions, and drawing conclusions.

D. VOLUMETRIC MEASUREMENT:

Application of the volumetric measuring system in milliliters can be explored after the students have become acquainted with the metric system of measurement. Each team of students is presented with two sizes of graduated cylinders, beakers, and flasks of varying sizes calibrated in milliliters, a 10 milliliter pipette and a 1 milliliter pipette. They are also presented with various and assorted jars. This being their first experience with a pipette, I usually ask them to determine the capacity of the pipette. "How can you check yourself to see if the pipette holds what you think it will?" "Can you verify the capacities of the other calibrated instruments?" "What is the volume in milliliters of one drop of water?" I feel that it is important for a student to project his knowledge of the metric system and learn to estimate in the metric system. I ask the students to estimate the milliliters in a teaspoon, an ordinary drinking glass, and a gallon jar.

Introducing the inductive approach in his science classes is a problem that each science teacher must face alone. He must consider the level of the students, the number of students in his class, and his facilities and equipment. There is no set way to employ the principles of inductive teaching; what works fine for one teacher may prove unsatisfactory for another. Although to succeed in involving each individual child physically and mentally is the ultimate, many times compromises have to be made which may require that students work in groups or a group of students perform demonstrations. A surprising amount of inductive teaching can take place through class discussions or teacher demonstrations. A verbal or visual cue may succeed in promoting inductive thought patterns in the student.

Implementing a course of study as I have suggested is not without its problems. It is very time consuming both from the teacher's standpoint and from the student's. Progress at times seems painfully slow. I find myself saying, "But it would be so much faster just to tell them the answer." But when I stop to consider the over-all objectives, I ask, "Is quantity of material that important?" Of course, if we assume that the school system has an integrated and comprehensive science program (K-12), then the demand for subject matter is lessened at any one grade level, and the pressure for moving on to the next topic is reduced. Even though the problem-solving approach may not be the most efficient in terms of coverage of material, can we not justify this extra time if it results in a more meaningful experience, an experience that imprints upon the student not only knowledge of science, but the spirit of discovery characteristic of science itself?

MODERN MATHEMATICS: ITS INFLUENCE ON THE TEACHING OF THE THINKING PROCESSES

Jeremiah Floyd

During the two decades following World War II, mankind has witnessed the most phenomenal growth of knowledge in human history. The outlook of the present and for the future seems to indicate that we are in the midst of a knowledge revolution so great that it staggers the imagination. The Commission on Mathematics puts it thus (5):

> The heart of the matter is that we are moving with headlong speed into a new phase..., a phase beside which the industrial revolution may appear as a modest alteration of human affairs.

With this evident explosion of knowledge, most professional practitioners of teaching--learning, at any level, must recognize the difficulty of keeping up with all the developments in their own areas of specialty. Moreover, this difficulty presents problems which are compounded if these new ideas are looked upon as separate and unrelated entities.

A logical solution then is to consider the ideas embodied in a given discipline and to concentrate on two basic properties which Bruner (1) points out as essential points often overlooked by curricula planners: (1) how these ideas are related or structured and (2) what systematic series of operations are involved within the learner as he proceeds from simple to more complex ideas. These properties point out two key words, "structure" and "process." They form the basis for all modern mathematics programs and indeed the majority of attempts to update the teaching-learning of all subjects.

We turn then to a brief consideration of modern mathematics and the common characteristics among the many programs available. It is deemed unnecessary to specify the programs referred to here because most of them have been in existence for a half decade or more, and the professional literature has been replete with descriptions of a majority, if not all, of them. Programs vary in many respects, but each teaches concepts, and all have at least these elements in common (3):

1. Explanations are given of the "why" as well as the "how" of mathematics. The student learns that every bit of manipulation he does in mathematics is done for a valid reason.

2. Extensive use is made of deductive reasoning and proof. The basic laws of logic are applied to algebra as well as to geometry.

3. The structure of mathematics is emphasized. The small number of basic assumptions upon which mathematics is founded are studied at all levels.

4. The discovery method of teaching is utilized.

5. Great emphasis is placed upon the precise use of language. The ability to read intensively for meaning is essential for success.

6. The new courses are built on unifying ideas (structure, operations and their inverses, logical deductions, valid generalizations, etc.) that are essential for the understanding of advanced mathematics. There is, therefore, continuity in the learning from the low to the higher stages.

The definition of "thinking" or "thought" seems to be elusive. The dictionary (7) refers to thinking as "the act of producing by mental processes or to effect change in some way, by mental operations." Writers, in general, have tended to scrutinize the processes and study the levels of their operations. Rugg (6) referred to the processes in terms of "the conscious--non-conscious continuum." Piaget (4) differentiated the levels of the processes into "intuitive" and "analytic" thinking. All of these, though somewhat different in nomenclature, have a common concluding theme--the objective of thinking is to produce meaning! Further, Bruner (1) points out, "meanings do not just happen.... Instead, they grow out of experience as that experience is analyzed and progressively reorganized in the thinking of the learner."

It is, therefore, the contention of the protagonist of most modern mathematics programs, that centralizing mathematics instruction on the key words "Structure" and "Process" provides fertile fields for experiences to develop which will augment and enhance the thinking process. For the past three years this writer has worked with seventh- and eighth-grade pupils teaching the School Mathematics Study Group curriculum entitled Mathematics for Junior High Schools. These materials emphasize the use of the discovery method and provide many opportunities for reflective thinking and refinement of the thinking process. These experiences have led one to support the position expressed by the protagonists. Experience also has shown that students who are effective readers tend to develop a more sophisticated level of refinement of the thinking process than pupils who are less efficient in reading.

In summary, these facts appear to be evident: First, there is in existence an explosion of knowledge which necessitates the development of a greater comprehension of how learning occurs. Second, a large portion of that comprehension may be developed through a careful study of thinking and the thinking processes. We can hope to induce effective learning in direct proportion to how much we ourselves know about its processes. And, finally, modern mathematics, which is a reorganization of the mathematical content, teaches the "why" as well as the "how." It has and will continue to influence the teaching of the thinking process.

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APPENDIX

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APPENDIX

Theorists and researchers have not neglected the theme of our publication. Indeed, they have made significant contributions to the important educational task of teaching early adolescents to think. The fact is, however, that many junior high school principals who are charged with responsibility for quality instruction find it extremely difficult to implement the expositions and findings of educational writers.

The situation is not hopeless, however, and there is some evidence that principals possess some optimism in looking to the future. Evidence exists, too, that principals are very much aware of the multiple barriers to effective methods of teaching thinking.

One-hundred-sixty-seven junior high school principals representing member schools of the Junior High School Association of Illinois were asked to indicate future plans as well as existing barriers to teaching early adolescents to think better. Here are the results:

Future Plans

1. More involvement of students in project work in contrast to the use of the lecture method

2. More emphasis on "problem solving" experiences

3. Faculty discussions on improving techniques for more effective teaching of concepts

4. More opportunities for individual study and thought

5. To develop an effective guidance and counseling program

6. Participation in a state-sponsored program for the gifted

7. Minimum use of workbooks

8. Use of team teaching in specific problem areas

9. Provision of a wholesome emotional climate in the classroom

10. Participation in workshops in the area of divergent thinking

11. Encourage teacher training programs which make use of inductive methodology and the processes of inquiry

Barriers

1. Teacher and teacher technique - insufficient opportunities for pupil participation and limited recognition of each pupil

2. Society's emphasis on conformity

3. Social stigma attached to nonconformance

4. Teachers who talk too much and "spoon feed" lessons

5. Teachers' insistence on tangible marks on which to evaluate students rather than teaching in terms of broad concepts which don't lend themselves to specificity

6. Structure in education in which we stress what we can measure

7. Inclination of teachers to teach didactically and deductively

8. Inadequate teaching personnel and too great a reliance on textbooks and workbooks

9. Adults (parents and teachers) who tend to "think for" young people and who assume that young people should think just like adults

10. Structured curriculum with little flexibility plus emphasis on the learning of factual materials

11. The race for college admissions in which marks serve as the sole criterion for measuring school success

12. A stereotyped formalized classroom with a teacher who lacks enthusiasm

13. Pressures of advancement in science and social change

14. Inadequate knowledge for appraising progress in thinking

15. Tradition that repels change or approaches which appear to make the teaching task a little more difficult

16. The general attitude of "it will do..." where there is little pride in completeness and accuracy

17. An instructor who is completely subject matter orientated

18. Methodology which places a premium on pat answers to questions

19. Textbook teaching which does not provide analytical views of the multitude of facts

20. Too much regimentation and memorization

21. All right. Let's be blunt! We don't know how! Why? Because the teacher is taught that critical thinking is like God, motherhood and morality--it is good; but not what it is. Critical thinking must be broken down into its elements and attacked in this manner.

One junior high school principal requested that his teachers submit statements to him setting forth the nature of their efforts to improve the thinking skills of their pupils.*

On the following pages appear a few of these formal statements:

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*Geneseo Junior High School

Encouragement of Thought

The process of learning is made up of a number of distinct functions. This is especially true in the exact sciences. At least in the earlier stages of learning, memorization and rote performance are of value as tools for accomplishment. Once such effort has been completed, the application of these general tools to other areas becomes important. The expansion of learning, then, is thinking. It is to these ends that the teacher must concentrate.

Basically, three general methods of encouraging individual reasoning are being emphasized in this classroom:

1. Reinforcement. As a general concept is introduced and expanded, specific situations are presented through written problems, drill sections, and discussion of the processes involved. Many side applications are brought into play. As an example, in teaching mathematical percentages, situations concerning the borrowing of money are brought under consideration, along with tire wear due to underinflation, fees charged for buying and selling stocks, batting averages, and so on. These specific situations are quite varied one from another, but they all cluster around the central hub of the concept involved. Application to the concept becomes a matter of thinking practice as well as mere drill, since the many facets of the basic principle become increasingly recognizable through repeated but varied associations.

2. Participation. Very often, individual thinking may be the result of group action. Group discussions, even to the point of argument, if constructively directed, are a prime method of encouraging analytical thought processes. Work before the class in the form of reports or the relaying of personal experiences pertinent to the subject at hand are beneficial to the total experience of the other students. Blackboard work and other demonstrations by the students themselves often graphically draw the attention of classmates to certain concepts being considered, and general principles will be reviewed in the minds of each student. Any participation on the part of class members will also develop within each member a sense of awareness of the background material, since he is himself presenting a specific situation. He becomes a part of the problem, and a leader, rather than merely a spectator. Involving the greatest number of students possible into active participation and responsibility cannot be overemphasized.

3. Research. Information researched or developed by the student is of particular importance to his concept of any basic process. He will, through his efforts in a specific area, create within his thinking a pattern of understanding in the broad field, as well as in that specialty being considered. Inquiry into various special projects or topics by way of books, firms, or individuals outside the classroom will most certainly increase knowledge and respect for the basic principles, which will be of indirect value to the student in many other instances. Projects may almost without exception be tied to many other specific instances through the thinking patterns developed as a result of the experience.

There are certain basic limitations to the unhampered encouragement of thinking in the classroom. The chief of these will be the heterogeneous nature of the class. Even in the so-called graded classroom, a wide variety of experiences and peculiar abilities will be noted among the members of the group. Since the class tends to be stereotyped to some extent due to time limitations, standard texts and presentations, etc., intellectual reactions by each student will not be the same. Therefore, it is often difficult to determine the effectiveness of a certain approach or application of a presentation, or to direct its full impact on the thinking process of each student.

Texts tend to include a wide variety of applications to a relatively few basic principles, and this vast array of material may in itself tend to limit the associations that should be brought about by thinking processes. It would seem that great care should be taken to show tie-ins between the different specifics, especially at the beginning of study on each new basic concept. Emphasis of the concept should be made in each specific area considered, as an aid to the formation of a habitual association process on the part of the student.

To teach the student the art of thinking, then, is a matter of seeing forests, rather than trees, even though the trees are the items that are attacked, one at a time. A common sense attitude of application of details is all-important if the student is to be motivated into reasoning and performing at a level that will be of value to his class and himself.

English

It seems to me I spend the largest percentage of my time trying to teach the slower learners to think, rather than jumbling together a large conglomeration of facts which are meaningless and which they can't remember anyway. The biggest problem is to give each one of these people enough time to think out a situation and to get them to take enough time, for they often have "jumpy" minds. Also, if we get beyond the point of their understanding, the whole thing is of no value and no interest.

In English we write short paragraphs playing up ideas and whether or not what a person says makes sense. These are often read aloud, rather than handed in for a going-over with the red pencil. Punctuation marks in written work are studied from the standpoint of making meaning clear. A movie shown early in the year, "Punctuation, Mark Your Meaning," shows how various changes in punctuation change the meaning of various sentences. It emphasizes that you should think through what you really mean to say or get across. Other good movies for this are "Making Sense with Sentences," and "Building Better Paragraphs."

We also try simple outlines to try to teach the pupils to organize their thinking and to show the importance of some things as compared to others. I also have a special movie on this called "Building an Outline," which I use to develop interest.

Our special workbook "Basic Reading Skills for Junior High School," has many interesting little stories and articles emphasizing main ideas. Some of these are fables, some Indian stories, some sports stories, and many other types of a great variety. The title of one page is "Why Did They Say What They Did?", and the pupils look for clues. I never allow them to help each other on these pages, and I try to refrain from too many suggestions myself. It is far too easy to let someone else do the thinking! They must be encouraged to do their own thinking rather than always having a crutch to lean on. Another page I like is "How Did He Solve the Problem?", with such questions as "What is the Problem?", or "How do you think Ted will solve it?" They must think up an answer themselves according to facts presented. Then we all listen to their solutions and try to see if they are reasonable. A good laugh often adds to the fun and brings out either some excellent answers or else shows up the ridiculous ones. I can't help but feel that a sense of humor is a valuable asset, particularly in dealing with slower pupils who lose interest so fast. When they have lost interest, they aren't thinking, so it is a constant struggle to keep them interested.

In English I feel we should emphasize creative imagination rather than a stifling mixture of grammatical forms. Correct grammar can be taught as incidental to creativity, and from the standpoint of getting ideas across.

In social studies, particularly, the continual use of objective type tests, reviews, and daily quizzes tends to promote snap judgments and to do little or nothing to promote thinking and judgment. There are many topics that cannot be discussed with "Yes" or "No" or fully explored with one-word answers. We need paragraphs using cause and effect, explaining the significance of events, and showing the interrelationship of various happenings. We need thought about our problems of today. Panel discussions on timely topics are helpful. Each group of five or six pupils selects a chairman and a lively discussion follows. A secretary briefly writes down any important points brought out and reports to the rest of the class.

In order to do any of the above things I have suggested and to do them well, teachers must have small enough classes for individual attention. It takes time to correct themes and paragraphs and to carry out well-organized projects. This is one reason why many sincere teachers of today feel that it is impossible for them to do their best work.

English

Methods of teaching pupils to think:

1. Without use of the dictionary, define an unfamiliar word by its context.

2. Have class discuss whether they agree or disagree with the way an author feels about any subject. Could you feel the same way about a fox hunt, for example, as the poet?

3. Tell why the title of a story is appropriate. Have class suggest other suitable titles for the same selection.

4. Learning to apply rules to specific examples is an exercise in "thinking." For example, applying the rules for forming plurals of words or using commas correctly.

5. Learning to identify the topic sentence of a paragraph would also call upon reasoning ability.

6. Acquiring skill in outlining material requires "thinking" to choose main topics and subtopics.

7. Practice in writing clear, concise sentences and short paragraphs requires the use of knowledge of the parts of speech and construction of a good sentence.

8. Compare or contrast one story with another or one author with another. Which do you like better and why? Does the author present facts or give an imaginative account of a situation? Is it true-to-life?

It seems to me these are only a few of the innumerable ways an English teacher may encourage students to put on their "thinking caps." Surely no class could become history without some thinking being done!

Geography

1. Acquiring ability to gain information from all kinds of maps requires concentration.

2. Develop outlining skill.

3. Discuss how geographical features of a country have influenced its history and people.

4. After studying a certain country, assign a paragraph or theme with pupils imagining they are living in the country studied. How would their lives be different? How would they feel?

5. Liberal use of current events and topics that are currently controversial. Why do you take one side or the other?

Approaches to Student Thinking

Two of my favorite methods of stimulating the thinking of science students are laboratory activities and demonstrations. For example, in the unit on sound, I set up an activity which consisted of having the students blow into test tubes in which varying amounts of water were placed. They were required to pinch one end of a straw together and blow until they got a sound. Then they cut off the end of the straw an inch at a time and observed what happened. They were told to write the results of both activities and then to write a conclusion. With some help, most of the students were able to come to the conclusion that a shorter air column gave a higher pitch. I try, as far as it is possible, to use simple everyday things that are familiar to the students during the laboratory periods. In this way they are able to go from the familiar to something new.

Whenever the opportunity presents itself, I will give demonstrations of my own in order to reinforce the concepts presented in the textbook. During class discussions, I attempt to be alert to any questions the students ask so that I can find out what is troubling them. Many times by taking these questions as a point of departure, I will begin by asking questions concerning things familiar to the students and attempt to lead them to the answer for the original question.

I also stress the vocabulary used in each assignment. I tell them that there can be no real understanding of any subject unless the students are familiar with the meaning of the words in the text. I strive to point out the definition of the words as used in everyday language, and the possible different meaning that the same word may have in the study of science.

Teaching Students to Think!

Although some of the processes in mathematics can be learned simply by drill and practice, we know that much progress can't be made without understanding. To develop this (or to teach the students to think), these are some of the methods used in my classes:

In presenting new material I always try to use the discovery method. As a group I may try to get the students, by questioning along with demonstrations at the board or with concrete objects, to discover the methods necessary to solve the new type of problems and the reasons for the processes. At other times I will have them make the discoveries individually, using their own methods until they can discover the correct method. Naturally, it is necessary to give some more direction than others.

A certain amount of informal proof is required--that is, a mathematical reason for every step in a problem. Having a student explain a problem to another or to the class teaches that student to think.

Inductive reasoning is used in "Problems without Numbers" in which the student may need to think of a specific problem so he can explain the necessary method in general terms. This is a most difficult task for pupils who can't think well.

In solving thought problems I emphasize the value of diagrams (drawing pictures) and when the answer is obtained--to ask the question "Is it a reasonable answer?"

The estimating of answers is another way of helping students think when solving abstract or word problems--as they must think through the process and learn to observe the relation of the numbers to each other.

Logic problems or puzzles are occasionally given to teach the students that conclusions can sometimes be reached, by trial and error, or logic.

Creative Thinking

In art, we try to incorporate a relaxed atmosphere while still maintaining a degree of controlled guidance. We have found that the best projects have come from informal discussion groups, problem solving, i.e., what materials would be used to construct an assigned project, etc.

Seeing the works of others, both classmates and professionals, old masters, etc., often helps the slow learner. Group projects are helpful, if the teacher assigns a slow person to a more creative group.

We often stop and analyze each other's work in class, using the positive approach rather than negative ideas.

Suggestions for improvement are:

A. More films (movie)

B. Slides--prints, film strips (permanent collection)

C. Tours to other art classes, museums, etc.

D. Demonstrations, discussions, from other artists

E. Use a wider variety of materials, extended uses of these materials

F. Experiment into new areas

G. An Art Club or groups that could do advanced work

H. Last, but not least, a very large working area where students could think big. Small table tops are very limited as to size of structure, i.e., sculpture, or large paper mache. Also, paper size is very limited to about 12 x 18. We cannot think in a creative manner if we are all forced to do the same size, shape, etc., project.

JUNIOR HIGH SCHOOL ASSOCIATION OF ILLINOIS

SUMMARY OF DRIVE-IN CONFERENCES - 1964

LOCATION	TOTAL ATTENDANCE	SPEAKERS	TITLE OF PAPER
CHAMPAIGN Host: Paul Sparks	42	Dr. J. J. Gallagher U. of I.	Creativity and the Early Adolescent
CHARLESTON Host: John Dively	80	Dr. Paul O. Gurholt E. I. U.	(Introduction of the Theme of the Conference)
DECATUR Host: Joseph Rutherford	103	Mrs. Sybil Carlson U. of I.	The Inquiry Process
DE KALB Host: Math Smith	35	Dr. Seymour Simon N. I. U.	Training of Original Learning
EAST MOLINE Host: Edward Hill	72	Mr. Robert Johnson Moline and Rock Island	Emotions and Thinking
		Mr. Neal S. Smith International Harvester	What Does Industry Expect of Public Schools Graduates?
EDWARDSVILLE Host: Robert Eberle	68	Dr. Gordon Bliss S. I. U.	A Proposal for a Course Designed to Teach Students How to Think
		Mr. Robert Eberle	Teaching Pupils How to Think: Some Divergent Thoughts
JACKSONVILLE Host: Edwin Engelbrecht	99	Mr. Maurice G. Kellogg W. I. U.	Inductive Methods of Teaching in Junior High Science
		Miss Alicia Tilley U. of I.	Personality Factors of the Adolescent Affecting Critical Thinking
KANKAKEE Host: Harold Hungerford	36	Mr. Robert E. Drew St. Charles	Thoughts on Thinking
OSWEGO Host: Ralph Ross	64	Dr. Harry W. Graly Chicago Heights	The Personality Make-up of the Teen-ager
		Dr. N. L. Pielstick N. I. U.	Creativity and Curiosity
WEST FRANKFORT Host: Oral Campbell	24	Mr. Stobert Abney Harrisburg	Ways of Stimulating Student Creativity in Home Ec., Shop, P.E., and Coaching